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FEBRUARY 15, 1936

Fifteen Mile Falls Development

Farmers Look Askance at Co-operative Lines
Selecting Motors and Controls for Fans
Purchased Power Drills Deep Oil Wells
Limits in A.C. Transmission

Block Consumption Rates to Straight Lines
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Ground Resistance Found in One Boring
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Choice of fan motors, survival of a.c., merchandising velocity, rate analysis simplification, obstacles to co-operative farm lines.

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Fans call for well-chosen motors and control. Oil drilling represents sizable electric drives. D.c. holds no vital threat to a.c. transmission.

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LETTERS TO THE EDITOR

Let's Not Regulate The Constitution

To the Editor of ELECTRICAL WORLD:

In addressing the *Herald Tribune's* Fifth Annual Forum on current problems, George H. Earle, Democratic Governor of Pennsylvania, in part said:

"The Constitution must be elastic enough to allow for economic evolution, 'and' if the court should rule that the federal government can not give labor the right to collective bargaining under the Wagner Bill, the Constitution will have to be amended."

Such pronouncement jumps to conclusions too quickly, because the Constitution of the United States has proved to be the most honored sanction for the preservation of people's rights that the world has ever recorded. It has been so understood, revered and respected for a century and a half.

Efforts to improve our social order cannot add to the fundamental definition of liberty and happiness. That definition is superior to any proclamation yet announced by any administration. Improvement of our social order necessitates no addition to the fundamental definition of liberty and happiness. No economic plan for our material betterment requires any addition to the fundamental definition of liberty and happiness. Mere economic plan cannot be raised to that level of importance which would permit comparison with the fundamental definition of liberty and happiness.

There is no issue for changing the fundamental definition of liberty and happiness. There is no issue for changing the Constitution. The Constitution has served us in peace and through war, during prosperity and through depressions for a century and a half. Is that not elasticity enough?

The Constitution of the United States states:

"We, the people of the United States, in Order to form a more perfect Union, establish Justice, insure domestic Tranquillity, provide for the common defense, promote the general Welfare, and secure the Blessings of Liberty to ourselves and our Posterity, do ordain and establish this Constitution for the United States of America."

Section 8 states:

"The Congress shall have power to regulate commerce among the several states. The Congress shall have power to provide for the common defense and general Welfare of the United States. To establish uniform laws in the subject of Bankruptcies throughout the United States."

There are no other provisions written in the Constitution to regulate business. In the 148 years since its adoption there have been twenty-one amendments. Excepting the Eighteenth Amendment, prohibiting liquor traffic, which was repealed by the Twenty-first, the rights of the several states and the liberty of their people defined by the Preamble and regulated by Section 8 have never been diminished. Furthermore, Article Ten specifically states:

"The powers not delegated to the United States by the Constitution, nor prohibited by it to the States, are reserved to the States respectively, or to the people."

These are the precepts defining the powers of regulation of business by the federal government. Nevertheless, the Federal Trade Commission and other federal departments have gone quite a distance in regulating business. This commission, together with the Securities and Exchange Commission and Federal Power Commission, has been clothed with great power of control and regulation of the electric power industry. We are in an era of regulation. When regulation becomes an obsession it erases the good that it purports to accomplish. Constructive regulation does not justify, nor does it necessitate, curbing beneficial private initiative. We cannot hope to improve regulation by government venture into the business which it would seek further to regulate under policies which are hostile to private enterprise and detract from Constitutional protection of the right to own property! Neither is prohibition an adequate substitute for wholesome regulating. We cannot cover up our errors made in regulating merely by more regulation. The cure is more basic than that.

When the government extends its regulation it assumes an added responsibility to the public. It purports to accomplish a non-discriminatory benefit for the people greater than the restriction which might be necessary to effect the regulation in question. Among other things, this necessitates accurate prediction of future conditions. We need only to reflect on legislation limiting farm crops to realize how imperfect a well-intended regulatory act might later prove to be. The powers of prognostication of men are not enhanced upon entering government office. Excessive zeal resulting in super-regulation usually time proves unwise. We might well consider whether the railroads have not suffered from over-regulation. It is difficult indeed to confine that permissible rate of earnings of any public utility within narrow limits and yet not retard its service. A generous surplus reinvested fairly in a utility property produces a public benefit far greater and of wider effect than any possible savings resulting from pecuniary regulation by rate cutting. Are we not carrying the idea of regulation to a point exceeding its possible benefit?

FRANK C. CZARNECKI,
Consulting Engineer, New York.

•

Helpful in Meeting Municipal Problems

To the Editor of ELECTRICAL WORLD:

The December issue of the ELECTRICAL WORLD reached my desk this morning. Please accept my thanks for publishing the article entitled "City Diesel Energy Costs Revealed." It makes a very readable story. The tables and chart should give interested public utility officials considerable information along lines that will be helpful in their municipal ownership problems.

J. S. HARTT,
Consulting Engineer, Madison, Wis.

•

Daylight on Lightning

To the Editor of ELECTRICAL WORLD:

Dr. H. Norinder's contribution on "Lightning Currents and Their Variations," which appeared originally in the *Journal* of the Franklin Institute for July, 1935, and was reviewed in the ELECTRICAL WORLD issue of November 23, 1935, sheds much of the desired light on lightning phenomena. The valuable data presented are conclusively indicative that the method employed by Dr. Norinder—*i.e.*, the recording of the magnetic field-variation of the lightning discharge—is still another effective approach in investigating lightning phenomena.

We are always interested in correlating such important data as these with those of other sources. In so doing due allowance should be given to the different methods employed in the field studies and also to the relative degree of accuracy in the measurement technique at this stage. With this in mind a comparison of the lightning current distribution curves, plotted on a percentage basis, shows surprisingly good agreement between the data published by Norinder, Sporn and Gross, Lewis and Foust, Grünewald and the writer. These curves will, no doubt, be the subject of further critique, amplification and refinement in the future. From the practical aspect it is now generally agreed that lightning-stroke currents range from about 10,000 amperes to a maximum in the order of 150,000–200,000 amperes. Further field investigations and studies are necessary to establish with more refinement the upper and lower limits.

The data presented in Fig. 2b (ELECTRICAL WORLD, November 23, page 84) are undoubtedly very pertinent. They confirm quantitatively the findings of other investigators, thus establishing with further assurance the duration of the individual lightning discharges as ranging from several to nearly 60 microseconds (full duration).

In view of the improved technique and the ever-more effective methods available for field investigation it seems reasonable to expect an early practical solution on the matter of popularity, multiple strokes, rate of voltage rise at the point of incidence to line of lightning stroke and a number of other lightning phenomena which are still open to question.

P. L. BELLASCHI,
Westinghouse Electric & Mfg. Co.

The wealth derived by excellent research on lightning is making possible practical equipments and methods for protection against lightning. Both technical and economic factors can now be evaluated with considerable accuracy because of this splendid research work.—EDITOR.

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PUBLISHED EVERY SATURDAY

FEBRUARY 15, 1936

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Busy Times Are Here Again—

Many concurrent happenings in the industry indicate a revival of activity in many lines. The engineers have had their midwinter meeting in New York, as well as the manufacturers. Utility engineering and commercial group meetings are now being held. Washington is a center of interest. Each local enterprise is busy with plans for sales and construction.

An aftermath of the A.I.E.E. meeting takes the form of two suggestions. One is that an Electrical Show be held in New York concurrently with the A.I.E.E. meeting every two years —a Power Show, A.S.M.E. combination, in principle. The reason is that this is the one large engineering meeting that now exists. A second suggestion is that A.I.E.E. expand its engineering activities to form local as well as national engineering committees to work on a continuous program so as to bring into this common forum constructive action by thousands of engineers. The reason is that this work is needed to vitalize the Institute and that no other forum now exists. Both these suggestions are worthy of serious consideration.

At the meeting of the electrical manufacturers the most striking happening was the acceptance and approval of marketing activities. Credit for this should be given C. E. Swartzbaugh and his N.E.M.A. committee. He pointed the way to expansion and profits and deserved a full house for his report as well as enthusiastic commendation and support by the board. The missing leadership in industry marketing is coming from the manufacturers. The record already made is very encouraging.

An interesting aspect of the business situation is found in the proposed "chain store" bill in Congress. This would prohibit discounts for quantity purchases. While striking at the chain store, the provisions would apply to all industry. Electrical manufacturers and large utility and industrial buyers should watch this new aspect of anti-monopoly legislation.

Equally significant to the electrical business is the forthcoming decision of the Supreme Court on the "Sugar Case." This is expected further to clarify anti-trust laws and help open the door to a procedure with the Federal Trade Commission that will get approval of trade practice agreements whose purpose is to stabilize competition.

On the human and sentimental side it is a pleasure to announce the launching of the Thomas Alva Edison memorial plan at the luncheon of the Edison Pioneers this week and also the completion of the plans of the A.I.E.E. to celebrate the fiftieth anniversary of the alternating-current system in all sections of the country. Both of these activities will serve to dramatize and to personalize the achievements of electrical men to the public and to interpret the social and economic values obtained through electrical technological contributions.

Another week at least of rumors about the T.V.A. case. The slowness in announcing a decision is having some detrimental effects on utility buying, for this case is of the deepest significance to the growth of government ownership in the power business. One happy piece of news is that the appropriations committee refused more money for the development of the Passamaquoddy visionary project.

Best news of all is the continued business activity that is recorded. From power stations to industrial plants buying is active and negotiations are still increasing in volume. This is going to be a big year in modernization and new construction. We anticipate little detrimental effect from the political campaign in the fall.

Sumner Morrow

Editor

Georgia Power's quadrupled staff of linemen knew no limit to endurance in efforts to restore service to the 4 out of 5 users who went without it for some part of the 8 days when 5 inches of rain fell — and froze. Their supreme effort won merited commendation from the Atlanta press and the public.

"THAT WE MAY HAVE COMFORT"

MOBILIZED LINEMEN ENDURE HARDSHIPS

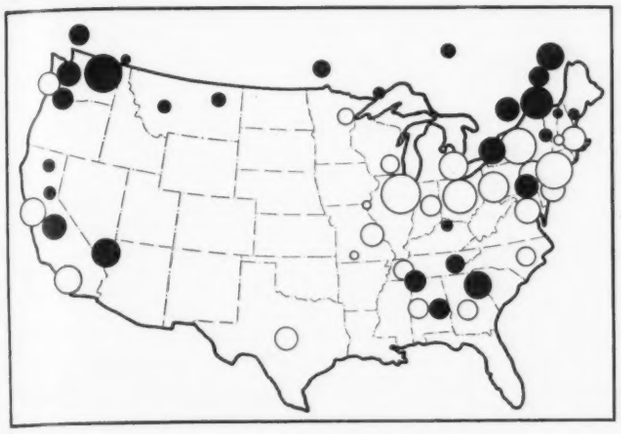


Fig. 1—Some hydro (black circles) adjacent to power markets (open circles)

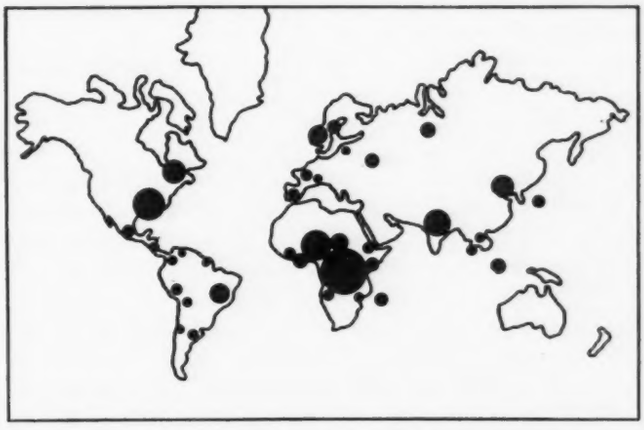


Fig. 2—Only Africa's Niger and Congo surpass U. S. water power

Useful Range of A. C. Power Transmission

Sixty-Cycle A.C. With Compensating Aids Looks Best Up to 1,500 Miles—D.C. Has Natural Advantages for Oil-Filled Cables

By H. H. SKILLING
Stanford University, California

OF ALL countries, the United States has the most to gain in the immediate future from hydro development and the transmission from these generally remote sources to the industrial concentration markets. It is important to review the possible means of transmission and, if possible, draw some conclusions. The analysis which follows appears to justify these conclusions:

1. For lengths up to 200 miles, ordinary 60-cycle alternating-current transmission is adequate.

2. The use of sectionalized line, with synchronous condensers, is indicated where the purpose is interconnection of central stations.

3. Compensating sections of inductance and capacitance are useful on most lines between 200 and 800 miles long.

4. A line tuned by loading is adapted to transmission over distances between 800 and 1,500 miles.

5. A line that is tuned by use of a non-standard frequency would be available for special cases of power transmission over distances exceeding 400 miles.

6. Low-frequency, alternating-current transmission is best for certain restricted power applications.

7. Direct-current transmission is most naturally advantageous in oil-filled cables of any length.

Power limit the crux

The limit that is encountered when it is attempted to extend existing lines to lengths of more than 300 miles, without special provision for maintaining stability, is due largely to the inductance and capacitance of the transmission line. Voltage regulation becomes bad, and in attempting to maintain voltage by the use of synchronous condensers at the receiving end it is found that the system will not operate with satisfactory stability, and also that the required capacity of the synchronous condensers becomes inordinate.

Since it is the distributed inductance and capacitance of transmission lines that limits their stability and that spoils their voltage regulation, direct-current transmission obviates these troubles. But it does so at the expense of such increased complication that it is desirable to review the possible methods of alternating-current transmission of power.

Five means have been proposed for transmitting power over long distances by means of alternating current: One is an extension of present practice, one is a compromise, and the other three systems balance inductance and capacitance so that it is appropriate to speak of the transmission line being "tuned."

1. *The Sectionalized Line*—It is common practice to use a synchronous condenser at the load end of a transmission line in order to maintain voltage at a constant value there as well as at the generator. It has been proposed (and the scheme patented) that longer lines would operate with good stability if synchronous con-

Tuned Line of 500 Miles

As an example of a line that is "tuned" by a compensating condenser and reactors consider a 60-cycle power line 500 miles long, of fairly standard construction: three-phase, 220-kv., three-stranded copper conductors each 1,000,000 circ.mil, equivalent spacing 20 ft. At some point along the line a π section of condenser and reactors is located, as in Fig. 3. It is not necessary that it be at the center of the line, although that location has a slight advantage. If E_S and I_S are voltage and current at the sending end of the line and E_R and I_R at the receiving end, they are related:

$$E_S = 1.00\,E_R + 26\,I_R.$$

The first term shows that the so-called "Ferranti effect" is absent and the second term shows the amount of voltage drop under load. It is interesting to compare this with a line only half as long (250 miles) without a compensating section to "tune" it; for such a line,

$$E_S = 0.868\,E_R + 184/86°\,I_R.$$

The "Ferranti effect" is considerable, and the voltage regulation is about seven times as bad as on the compensated line of twice the length. One may also compare the operation of the 500-mile line when the power is transmitted by direct current:

$$E_S = 1.00\,E_R + 28\,I_R.$$

This is practically identical with the operation of the line at 60 cycles when "tuned."

To obtain in practice transmission characteristics of a "tuned" line it is possible to make use of the exciting current of transformers at all substations on the line. Instead of placing the compensating section of inductance and capacitance in the center of the line, it can be divided into two parts, as in Fig. 4. The inductance, then, will be the inductance of the primary of the substation transformers; the lagging current that must be drawn from the line will ordinarily be greater than the normal exciting current of transformers, but special design will quite readily make the transformers serve a double purpose. When there are several substations on a line, each section of the line can be tuned separately, as in Fig. 5, and power can be used from the line at each substation without affecting to any important extent the voltage or stability at any other substation. By this means the "tuned" system can be extended as much as is desired.

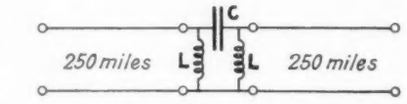


Fig. 3—Fully compensated tuned line

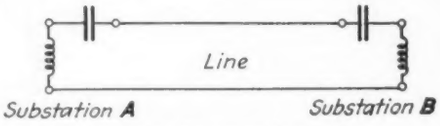


Fig. 4—Transformers designed to provide compensation

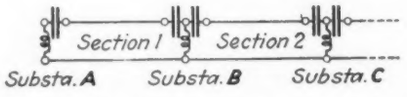


Fig. 5—Tuning external to sectionalized system

densers were located at intermediate points along the line as well as at the end. If there were a synchronous condenser every hundred miles and each one maintained rated voltage at its terminals the line connecting them could carry power for great distances. This system is a logical development of the use of a single synchronous condenser at the receiving end of the line, and its steady-state properties are good. Each line section acts as an independent unit except that each carries on the power supplied to it, for delivery to the next.

However, transient stability of such a system is questionable. Condensers are unable to maintain constant terminal voltage during transient disturbances and the sudden application of a relatively small load could destroy the stability of the system. Also, the mechanical swings and surges of the several synchronous condensers at times of sudden change of load might introduce uncertain and dangerous disturbances of stability. Finally, the cost of installation and upkeep of many synchronous condenser stations would be so great that only special conditions would justify the use of the system.

If many cities, each with its own generating equipment, were to be joined together by a several-hundred-mile-long high-voltage bus, to facilitate the interchange of power, this sectionalizing system would go into effect automatically. If, for example, a line from Chicago to New York were connected to all the large urban systems in those intervening states (where most of the country's power is consumed) it would readily carry power from Niagara Falls to New York City with every generator in central New York State helping maintain stability by acting as a synchronous condenser.

2. *Low Frequency*—The use of frequencies below the customary 60 cycles in order to reduce the inductive reactance and charging current of a line is merely a compromise between alternating and direct current. Transmission is improved to some extent, but low-frequency generators, motors and transformers are proportionately large and expensive. Also, low frequency is not adapted to lighting, and for domestic supply this is a highly serious objection and would make frequency changing equipment mandatory.

3. *The Compensated Line*—A proposal that properly lies in the category of "tuned" power lines involves the use of a static condenser in series with the transmission line. A line with a series condenser may be considered partially "tuned," for the capacitive reactance of the condenser compensates for the inductive reactance of the line and, hence, there is no reactive voltage drop between generator and load except that which is due to charging current. To make the "tuning" complete, it is necessary to have a reactor from line to ground as well as a condenser in series with the line; the purpose of the reactor is to draw current from the line, equal and opposite to the charging current.

With complete "tuning" the undesired effects of reactance and capacitance are entirely removed. There is no reactive voltage drop from one end of the line to the other and the line draws no charging current. If one were to propose *ideal* conditions of power transmission, quite apart from what is possible, one would specify a line on which the voltage would be the same at both ends, regardless of load, and with the current at the generator equal to the load current. Such would be the case if a line had neither resistance, inductance nor capacitance. But no line can be ideal, because of resistance. "Tuning" a line, however, will remove the effects of inductance and capacitance; then the line may be made as nearly ideal as is desired by enlarging the conductors and thereby reducing the resistance. No means of power transmission, whether by direct or alternating current, can entirely avoid resistance loss, so a "tuned" line is as nearly ideal as may be obtained.

The chief disadvantage of "tuning" by means of a compensating section is the necessity of using static condensers in series with the line. They are expensive, and they are liable to damage on overvoltage. The kilovolt-amperes of condenser capacity required is approximately proportional to the length of the line being compensated and to the square of the line current.

For the typical 220-kv. line that was used above as an example, "tuning" would require about 30,000 kva. of static condensers for each 100 miles of line when the line is carrying 150,000 kw. of power. The expense of such condensers seems less formidable when it is remembered that synchronous

condensers are not essential on such a system, for the voltage regulation of the "tuned" line per 100 miles length would only be about 2 per cent. They can be used if desired, however, for the synchronous stability of the "tuned" system is good. But it must be remembered that the necessary kilovolt-ampere rating of the condenser increases as the square of the line current, approximately, because when current is increased through the condenser its terminal-to-terminal voltage is also increased in proportion. In this respect it is like the line's I^2R loss, and like the I^2R loss it puts a large premium on high-voltage transmission.

Finally, there is the danger that accompanies accidental overload on the line. Since either overload or fault would draw a large current through the series condenser it would also produce overvoltage on the condenser. The condenser would have to be carefully protected against overvoltage, to avoid its destruction.

It should be noted in passing that it is possible to operate the condenser from a transformer in the line, and thereby make it unnecessary to maintain the whole condenser at line voltage.

A proposal that is worthy of most serious consideration suggests the use of a synchronous condenser, operating *in* the line instead of *across* the line, to replace the series static condensers. If the speed of response of excitation of such a machine can be made great enough to prevent transient instability, the problem becomes an economic one: Can a given kva. capacity be obtained most cheaply from static or synchronous condensers?

4. *The Half-Wave-Length Line*—To every frequency of alternating current there corresponds a wave length, such that the frequency multiplied by the wave length equals the velocity of propagation of the wave-train. This is familiar in radio work, and it is equally true of power frequencies. And if the length of a transmission line is just half of the wave length of the applied frequency, the line will be "tuned" and will have excellent characteristics of transmission.

A half-wave-length line is automatically "tuned," for the charging current of the line and the line's inductive drop always just cancel each other, and the load voltage is equal to the generator voltage except for the effect of line resistance, which of course cannot be avoided.

This can be readily shown, analytically, from the transmission line equations:

$$E_S = E_R \cosh \sqrt{zy}\, L + I_R Z_o \sinh \sqrt{zy}\, L$$

$$I_S = I_R \cosh \sqrt{zy}\, L + E_R \frac{1}{Z_o} \sinh \sqrt{zy}\, L.$$

In addition to the terminal voltages and currents:

L is length of line,
z is impedance per unit length,
y is admittance per unit length
Z_o is $\sqrt{z/y}$,
l is inductance per unit length,
c is capacitance per unit length,
ω is $2\pi f$, where f is frequency.

If, for simplicity, the line is assumed to be without loss, the equations become:

$$E_S = E_R \cos(\omega\sqrt{lc}\, L) + j\, I_R Z_o \sin(\omega\sqrt{lc}\, L)$$

$$I_S = I_R \cos(\omega\sqrt{lc}\, L) + j E_R \frac{1}{Z_o} \sin(\omega\sqrt{lc}\, L).$$

For the line to be "tuned," make the length such that $\omega\sqrt{lc}\, L = \pi$. This is true when the length of the line is half of the wave length of the applied frequency. The sine and cosine terms are then simplified to give:

$$E_S = -E_R$$
$$I_S = -I_R.$$

So, neglecting resistance, the line causes no voltage drop and draws no charging current. The minus signs indicate a reversal of phase between the ends of the line, but since both current and voltage are reversed there is no change of power factor and no instability.

Such conditions of transmission are highly desirable, but they are difficult to obtain. If it were desired to transmit power a distance of 1,500 miles a 60-cycle line would be a half-wave-length line and would be "tuned." Such distances are not in the present economic picture. For a shorter line the frequency must be correspondingly higher and a 500-mile line would be "tuned" at about 180 cycles. So if the distance of transmission is less than about 1,500 miles the advantages of half-wave operation can be obtained only by the use of frequency changers at one or both ends of the line. Even this might not be prohibitive if the advantages were sufficient.

The advantages are the same as those of all "tuned" lines: Good voltage regulation, good stability, no charging current supplied, and unlimited length. The disadvantages are: Non-standard frequency and a load limit determined by the line insulation. This last factor is due to a rise of voltage that takes place in the middle of the line when the impedance of the load falls below the characteristic impedance of the line; if the load drawn from a half-wave-length line at 220 kv. greatly exceeds 130,000 kw. the midpoint voltage will be greater than the terminal voltages. It is quite possible to insulate the middle section of the line to withstand increased voltage, and the increased voltage is beneficial in that it improves the efficiency of transmission, but still there will always be some power limit that cannot safely be exceeded. Since the power limit is determined by the characteristic impedance of the line, which is practically $\sqrt{l/c}$, it is possible to increase the power that may be taken from the line by either decreasing the line's inductance or increasing its capacitance. There is one combination of circumstances that provides a satisfactorily low value of $\sqrt{l/c}$ and that is sufficiently interesting to be worth mention in detail.

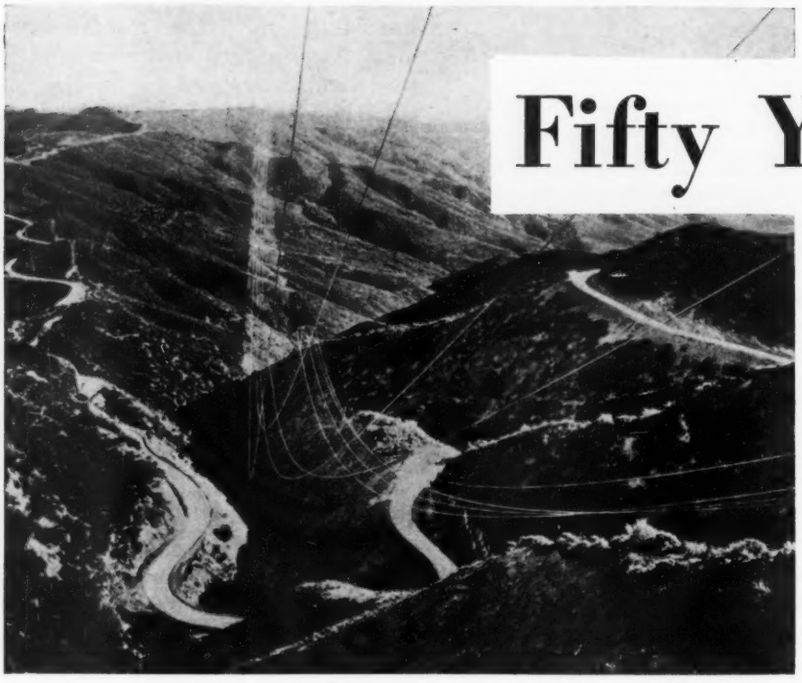
North America stands second only to Africa in water power. Water power alone makes long-distance transmissions feasible and necessary. Is our 60-cycle commitment all wrong or does d.c. promise to supersede a.c.? The author shows that each has its place and the two systems will advance together.

Compressed-air-filled cable

Entirely apart from stability problems, "tuning" and related matters, it is becoming continually more important to maintain continuity of service over a transmission line. Lightning, fog, sleet and other weather hazards cause most of the interruptions in high-voltage transmission, and they are largely unsolved problems. The underground oil-filled cable eliminates these troubles, but introduces a new group, of which the chief are dielectric failure, load limit due to heating and differential hydrostatic pressures. A highly promising strategy, which places the conductors within a sheath and yet eliminates oil, avoids most of the obvious troubles. The three conductors of a transmission line may be inclosed within a 2-ft. iron pipe and the air pressure within the pipe may then be increased to 10 atmospheres. The only available data, from tests by the late Dr. H. J. Ryan, indicate that at this pressure the dielectric strength of air is increased to ten times its value in normal air.

With all three conductors of a three-phase line inclosed in a 2-ft. pipe and with pressure increased to 150 lb. per

[*Continued on page 82*]



Over the mountains of California runs this 220,000-volt A.C.S.R. transmission line of the Southern California Edison Company

Fifty Years March

By F. REED DALLYE
Engineering Department,
Aluminum Company of America, Pittsburgh, Pa.

The a.c. system is celebrating its 50th anniversary and it happens that it is also just 50 years since a practical process for reducing aluminum was discovered by Hall. That process is dominantly electrical. Meanwhile, aluminum is handsomely repaying the obligation by perfecting its products to be of service throughout the electrical industry. Here is a review of how those functions have expanded in parallel.

ALUMINUM was not always the inexpensive, widely used metal it is now. There was a time when it was reserved for laboratory research and for jewelry, for it was worth far more than gold. Many scientists tried to find the way toward the inexpensive production of aluminum, but success was reserved for Charles Martin Hall, a young graduate of Oberlin College, who began his experiments during his study of chemistry and who completed them nine months after his graduation.

His process consisted of dissolving alumina (aluminum oxide) in molten cryolite in a carbon-lined cell and passing an electric current through the mixture. As the current passes through the solution, oxygen is liberated at the anodes and molten aluminum deposited on the bottom of the reduction cell. The amount of current required depends upon the size and design of the cell. It may vary from 8,000 to 30,000 or more amperes at about six or seven volts per cell. There are usually 30 to 100 cells in series, depending upon the voltage of the power supply. The amount of power used in the reduction of aluminum in the United States was about one billion kilowatt-hours last year. Before the depression this figure was more than twice as high.

To produce aluminum economically, it is obvious that large blocks of inexpensive electric power are essential. The first commercial aluminum in the United States was produced by the Pittsburgh Reduction Company by means of steam power, but only a few years after this company was founded its source of electrical supply for the reduction of aluminum came from the Niagara Falls power development, of which it was the first commercial customer.

Both the aluminum industry and the electrical power industry grew up at the same time, and right from the start an interesting reciprocation was to be noted. Not only did the aluminum industry consume a large amount of electrical power but the electrical industry found abundant use for aluminum. Because of the light weight of aluminum and its high electrical conductivity the advantages of the metal for overhead transmission were early recognized, and it is in this field that aluminum has found its widest electrical application. Compared with copper, aluminum has a cross-sectional area 59 per cent greater and a weight 52 per cent less, for equal conductivity.

Early aluminum transmission lines were made either of single wires or stranded cable. These conductors were too small to withstand severe weather conditions, they were too weak and they were too light. The wind whipped them together and caused burn-offs or serious mechanical weakening. The larger conductors gave a good account of themselves because their ratio of strength and weight to wind pressure was so much higher.

A.C.S.R. dates from 1909

The rapid growth of power transmission requirements resulted in the use of higher voltages, longer spans and a more insistent demand for uninterrupted service. A newer type of cable was developed in 1908, which had high mechanical strength combined with suitable electrical characteristics. This new concentric stranded conductor consisted of an aluminum envelope over a central core of high-strength galvanized steel. It was called aluminum cable, steel reinforced (known generally as A.C.S.R.). The first A.C.S.R. line was installed in 1909, and in the 26 years that have followed more than 430,000 miles of A.C.S.R. has been placed in service in the United States alone, with the field of application ranging from low-voltage distribution service to 220,000-volt transmission lines.

A.C.S.R. is essentially a high-

# of Aluminum

Ensconced as Transmission and Distribution Conductor and as a Busbar Material With Promise of Appearance in Coil Windings

strength, light-weight conductor and its principal advantage lies in the construction of long spans with flat sags. These characteristics are of particular importance in the construction of rural lines, which in recent years have occupied a considerable position in the expansion program of power companies.

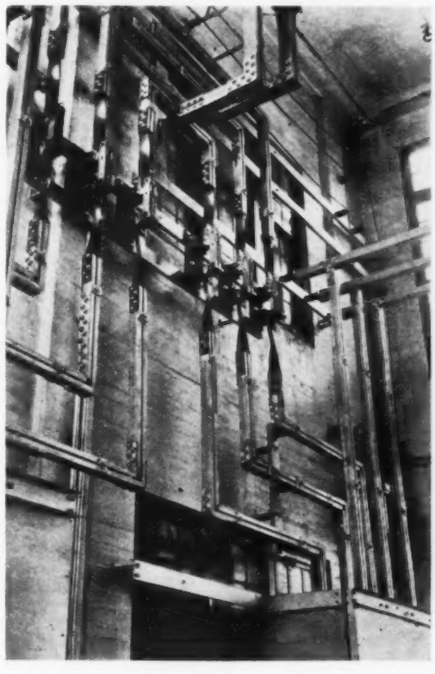
The diameter of A.C.S.R. is necessarily larger than that of the equivalent solid or concentric stranded copper wire. This larger diameter results in larger assumed ice and wind loadings in sag calculations and partially reduces the high-strength-to-weight ratio. The larger diameter of A.C.S.R. has been a natural advantage on lines operating at the higher voltages, because voltage and conductor diameter are the major influences on corona loss.

From long spans to thin rurals

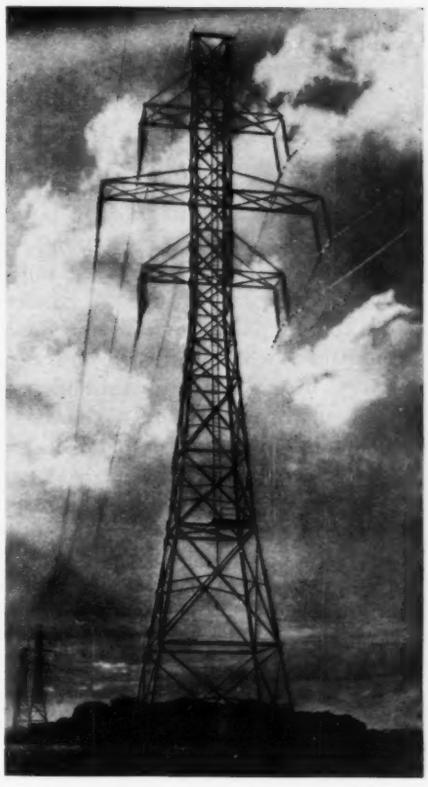
The proportion of steel reinforcement is easily changed, so that the relation of strength, weight, diameter and carrying capacity can be varied to suit different conditions. Specially proportioned cables have been particularly advantageous for long-span, high-clearance river crossings that require great strength. There are seven such crossings over the Mississippi River and a large number of even longer ones scattered over the country. A similar application of specially proportioned A.C.S.R. may be found in overhead ground wires where sags are preferably flatter than in the power conductors. The urge for further economy in rural line design caused the development of a cable having seven aluminum strands over a larger steel wire core. Such cables are 25 per cent stronger than the former concentric stranding of six aluminum wires over one steel wire all of the same diameter, but the increase in cable diameter is less than 3 per cent.

An application of aluminum just as old as aluminum cable is aluminum busbar. The first installation of record consisted of groups of round rods for feeding the electrolytic pots in the first Niagara Works of Aluminum Company of America. Aluminum busbar is today available in three general forms—flat bar, tubing and structural shapes. Channel conductors have been available and in use since 1929 and have proved to be an excellent type for heavy alternating currents or wherever great rigidity is required for long spacing between supports, or for severe short-circuit loads.

The resistance of aluminum to the corrosive effects of industrial atmospheres makes it particularly suitable for electrical conductors. Aluminum busbar likewise resists attack by many chemicals. The plating industry, for example, has found it satisfactory where several types of acid are used in the production processes.



Aluminum busbar feeds electric steam boilers



Double-circuit suspension towers carry 220,000-volt lines

Beauharnois Light, Heat & Power Company lines of A.C.S.R. over the St. Lawrence River

Closely allied to busbar are bus and cell inclosures. In former years they were made of stone and concrete, followed by the application of steel. Within the last few years, however, engineers have favored non-magnetic housings of suitable thermal and electrical characteristics wherever heavy alternating current is to be transmitted. The light weight and high strength of aluminum alloys invite designing for great rigidity.

For the protection of insulated wires and cables aluminum conduit is in common use in localities where corrosive conditions make it desirable. Where outside wiring is necessary, on beautiful edifices and imposing public buildings, the use of aluminum conduit is advisable because it does not streak or stain adjacent stonework or paint. The light weight of aluminum conduit has been exploited in the construction of rolling stock, particularly on the newer subway lines and electrified railroads.

Aluminum flexible conduit and cable, armored with basket-weave strong alloy wire, are being used in

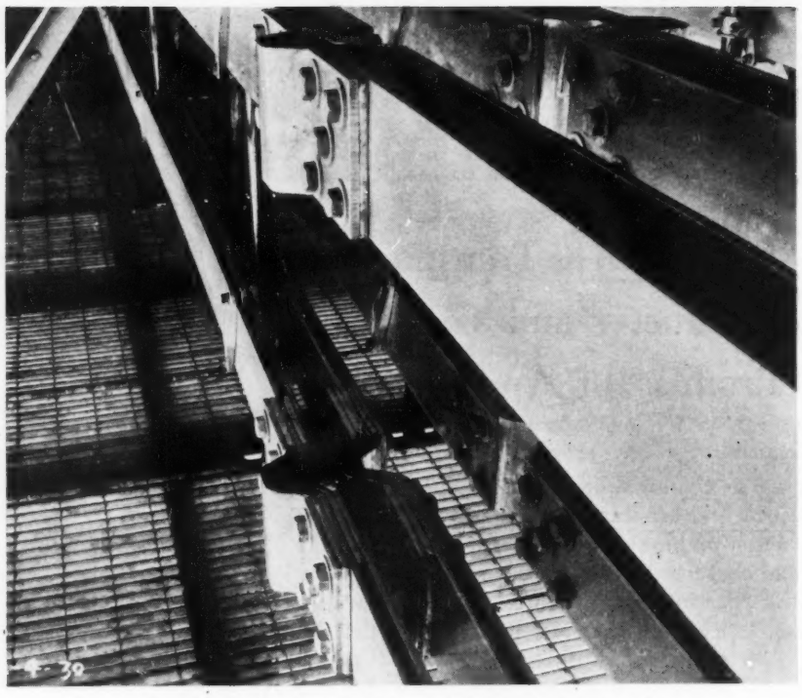
airplanes, lighter-than-air craft, automobiles and ships.

Manifold uses perfected and in prospect

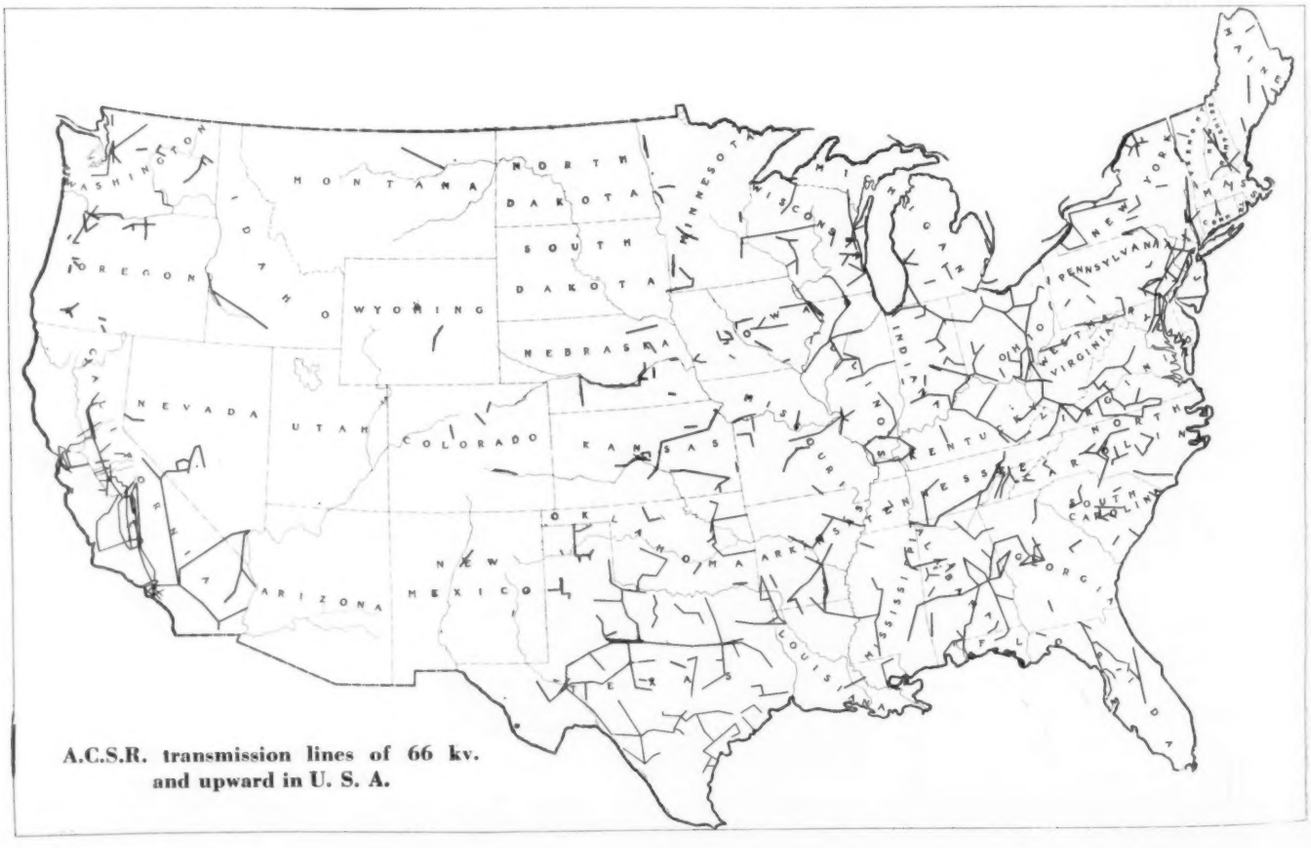
A newer use of aluminum cable is represented by installations on buildings and tall structures for lightning protection systems. Specially stranded cables have been provided for connections to rod points and for the down conductors, while supports and connectors of cast aluminum and rod points of wrought material are used.

Aluminum wire can be coated electrolytically with a layer of aluminum oxide, extremely thin but also extremely durable. A coating fifteen mils thick has a breakdown value of several hundred volts. In the not too distant future such wire will be supplied commercially for motor windings, solenoids and similar electrical equipment. The wider use of high-speed alternators in the future will make it necessary to develop lighter field coils to reduce inertia stresses. Here such aluminum wire, insulated by the oxide coating, unaffected by high temperatures, will become extremely useful.

Fifty years, after all, seems long only at the start. The Chicago stockyard operator who installed an aluminum telephone line many years ago may not have known that he was the first to use aluminum wire to conduct electricity, but neither did he know that his puny order would be followed by millions of pounds of wire and hundreds of thousands of miles of cable. To speculate upon the next 50 years is idle. Aluminum is an established metal; it is the most common metal in the earth's crust; it is a most versatile material and may be found in almost every industry. Its future appears brighter than its past, for the first 50 years in its history provided only the foundation for its rapid advancement.



Aluminum used for 230- and 600-volt d.c. busbar



A.C.S.R. transmission lines of 66 kv. and upward in U. S. A.

Selecting Motors and Controls for Large Fans

Calculation of Acceleration Time and Current—Protection During Starting and Running—Torque Reversal With Drop of Speed—Synchronizing Requirements

By R. C. ALLEN
Industrial Application Engineer
Westinghouse Electric & Manufacturing Company, Philadelphia

LARGE-DIAMETER, low-speed fans have considerably greater inertia than the higher-speed units, and the motor, because of its lower speed, may have relatively lower torques available for accelerating this mass to full speed. While the combined motor and control which will start a fan can bring it up to speed, the time required may cause overheating of the motor or cause the overload trip to disconnect the motor, unless both are designed for the slow acceleration.

This is particularly true with multi-speed, multi-winding, squirrel-cage motors. On the low speeds the fan and its inertia are abnormally large for the motor horsepower and torques when based on the rating required by the fan. With such drives it is necessary to check the accelerating time accurately to determine the motor heating and correct type and setting of the overload protection. This is best done by plotting the fan and motor torques and motor current against speed and then calculating the accelerating time and r.m.s. current. The amount by which the motor torque at each particular speed exceeds the fan load torque is the torque available for accelerating the connected mass or WR^2.

The process of calculating the accelerating time and current can best be illustrated by considering a specific motor and fan load as represented by Fig. 1 (a and b) with the accompanying data. The low-speed winding generally consumes the greatest time for accelerating to its full speed so it will be considered.

In this case the total WR^2 to accelerate is 656 lb.ft.^{2} and the acceleration time can be calculated by the step process from the formula $t = \dfrac{WR^2 N}{308 T_a}$

where t = time in second per step, N = change in r.p.m. per step, T_a = average excess torque per step. The greater the number of points calculated the more accurate the results. The calculated results are:

1. Final r.p.m.....	25	50	100	200	350	450	500	550	585
2. N.....	25	25	50	100	150	100	50	50	35
3. Ta.....	4.1	2.1	2.6	3.6	3.6	2.0	1.0	1.2	2.2
4. t.....	8.9	4.4	5.1	7.6	7.7	4.3	2.1	2.6	4.7
5. Elapsed time....	8.9	13.3	18.4	26.0	33.7	38.0	40.1	42.7	47.4
6. Amperes.....	17.5	17.3	17.0	16.8	16.0	14.3	12.5	8.3	3.8

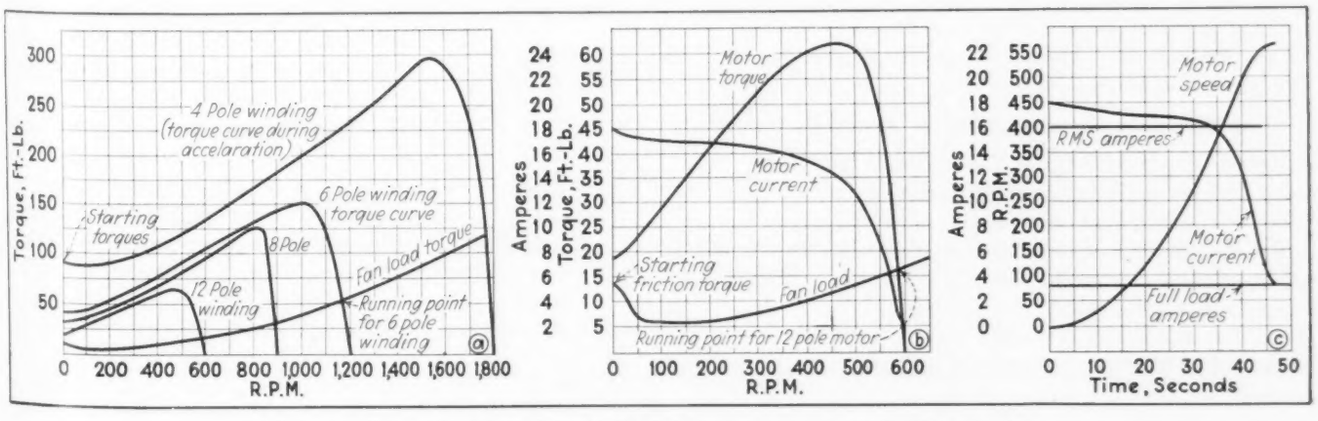


Fig. 1—Best motor characteristics chosen for tunnel ventilating fan

(a) Motor and load-torque curves for a four-speed squirrel-cage motor driving fan. The motor is rated 40 hp. (1,770 r.p.m.), 11.9 hp. (1,170 r.p.m.), 5.5 hp. (890 r.p.m.), 1.8 hp. (585 r.p.m.). The fan load is based on a V-belt drive, 12 per cent starting friction, 5 per cent running friction and air-load torque varying as square of speed.

(b) Load and motor torque and current characteristics for lowest speed winding. Fan, sheave and belt WR^2 referred to motor shaft = 593 lb.ft.^{2}; motor WR^2 = 63 lb.ft.^{2}; total WR^2 to accelerate 656 lb.ft.^{2}.

(c) Motor speed and current during acceleration. Based on step-by-step calculations for lowest speed of four-speed motor (Fig. 1a). The r.m.s. value of the current determines the heating during acceleration and consequently the ability of the motor to stand the long starting time of high-inertia fans. The increments chosen for the beginning of the starting cycle should be small to determine accurately this portion of the curve.

The currents given above are read directly from Fig. 26. From the first, fifth and sixth lines in this table Fig. 2c can be plotted to show relation of motor speed and current to time of acceleration.

The heating effect of this current is determined by obtaining its r.m.s. value based on average acceleration currents during each five-second interval over the starting period, as follows:

Time.....	2.5	7.5	12.5	17.5	22.5	27.5	32.5	37.5	42.5
Amperes.....	17.8	17.5	17.2	17.0	16.9	16.8	16.2	14.6	8.8
Amps^2.....	316.8	306.3	295.8	289.9	285.9	282.2	262.4	213.2	77.4
Summation.....	316.8	623.1	918.9	1,207.9	1,493.8	1,776.0	2,038.4	2,251.6	2,329.0

Aver. (Amps.)^2 = 2329/8 = 291 R.M.S. amperes = 17

As 3.2 amp. is full load, the above value represents five times full load current for the 47 seconds of acceleration. This would not produce any serious strain on the insulation provided it is not already above its allowable temperature due to other and frequent starting. As there is little or no insulation in the squirrel-cage rotor windings of the induction and synchronous motors, the stator winding temperature is the one necessary to consider. Occasional peak temperatures due to starting are not considered objectionable, but frequent starting or long-time starting may cause insulation heating strains, resulting in reduced life of the motor. For such cases the motor manufacturer should be consulted for probable results.

Calculation of the starting time and r.m.s. current for the other windings would show shorter acceleration times but higher currents. However, with the conditions known, motors can be designed to withstand the resulting heating whether started from rest for each winding or progressively to the high-speed winding.

Protecting the insulation

Overload trips (Fig. 3) of the bimetallic type follow the motor heating due to load changes very closely and with the inverse time characteristics give adequate protection for normal operating conditions. For heavy starting duty, as with fans of high inertia, it is desirable to use a saturating-type current transformer which limits the current affecting the overload relay and prevents tripping of the control due to the high starting current, except for unwarranted long starts, yet permits a close, continuous load setting. Occasionally even this is not adequate because of the long accelerating time and it is then necessary to have one overload trip relay for starting and another for running to secure adequate protection for both conditions.

These problems of ample accelerating torques and adequate overload protection are not found with the slip-ring motor drive, but the higher overall efficiencies of the squirrel-cage motor, at least for the lower speeds, as well as their simplicity make them desirable particularly where the major operation may be at the lower speeds. Special squirrel-cage motors could be designed with higher torques for the starting current or greater thermal capacities, but motor characteristics are so interdependent that improvement of one characteristic is usually at the sacrifice of another, generally resulting in low efficiencies.

Reduced voltage starting is of no advantage for reducing heating. The energy necessary to accelerate the mass, and therefore the heating, is essentially the same independent of the time consumed. The heating due to the air-load current and the magnetizing current are more dependent upon time consumed. The choice of type of starter depends upon other factors than the accelerating time.

Another problem that should not be overlooked with multi-speed squirrel-cage motors is the torque that may be transmitted to the fan when transferred to a lower speed (Fig. 4). The inertia of the fan prevents the motor from dropping to the lower speed instantly or before the time required to reconnect the motor to the power unless a time delay is incorporated in the control. Under these conditions the motor is acting as an induction generator driven by the fan. This not only gives a reversal of torque on the fan arms, but a torque generally much in excess of the normal maximum torque. If when running at the top speed the motor is connected to the three-fourths speed winding, the reverse torque, as shown on the curves, would be over 450-ft.lb., or the fan would be exerting about 4½ times full-load torque in the reverse direction and actually driving the motor above the synchronous speed for that winding.

The fan arms should therefore be designed for this operating condition or else a time delay incorporated in the control which would prevent connecting the lower speed winding until the unit had dropped to at least the winding speed. It is imperative also that the drive, particularly if a belt, be selected with sufficient capacity to transmit the torques developed by the motor and fan without slippage or other undue strain. These peak torques and long accelerating times

[*Continued on page 71*]

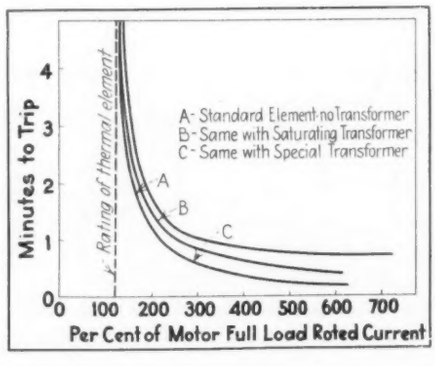


Fig. 2—Characteristics of thermal overload relay

Curves are based on starting cold. Repeated starts lower the curves. Bimetallic overload trips follow motor load heating very closely and inverse-time characteristics give adequate protection for normal operation. Saturated-type current transformers prevent high starting currents tripping the overload relay, except for unwarranted long starts, yet permit a close continuous load setting. With long accelerating time, one overload trip can be used for starting and another for running to secure adequate protection under both conditions.

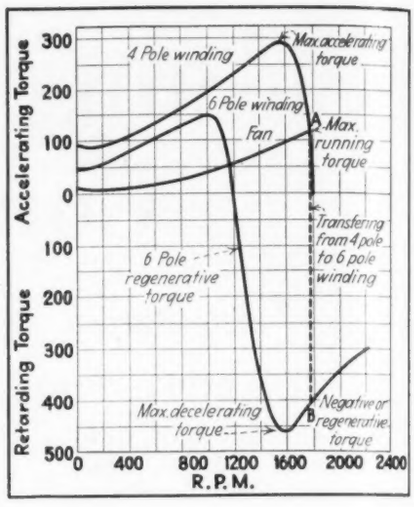


Fig. 3—Effect of changing from high- to lower-speed winding

Speed-torque curve of the lower speed winding extended to show regenerative torque when run overspeed. If no time delay is provided in control the fan inertia will tend to maintain speed after transferring to lower-speed winding, which results in reverse torque strains in equipment much in excess of running torque.

One Boring to Find Ground Resistance

Two-Electrode Device Measures Resistivity from One Side of Bore Wall to the Other—Obtains Stratification Data for Planning Grounding System

By R. J. OWENS
T.V.A., Chattanooga, Tenn.

TO SECURE complete field data on ground conditions it is often necessary to make resistivity tests of earth at various depths below surface as well as at various locations. The writer developed the following direct method of measuring earth resistivity at various depths. It offers advantages that cannot be obtained by indirect methods.

A special earth auger is used to bore test holes and a set of electrodes with expanding device is used to facilitate the measurement of earth resistivity in ohms per cubic centimeter at any depth. Measurements are made in undisturbed earth immediately surrounding the test hole, or to a set of reference grounds some distance away.

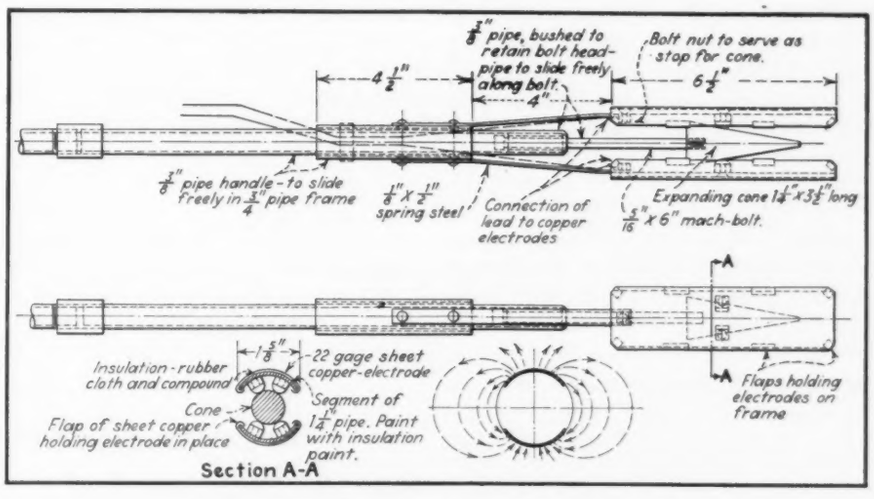
The auger is designed to bore and ream out a test hole having a smooth wall. The bit cores out the earth and worth-while observations can be made of earth removed at various depths. One man can operate the auger, although it is designed for driving with a maul or sledge while being turned. For driving, the auger should be well constructed of good material so as to withstand the twisting action on the point. Holes at the joints permit the use of a piece of $\frac{3}{8}$-in. pipe for assembly instead of a pipe wrench. Besides being adapted for this kind of testing, the auger is believed to be much faster under ordinary conditions than other types and should serve splendidly for other purposes, such as boring lead holes for screw anchors or for Malone type concrete anchors.

The testing electrodes are arranged to insert into an earth hole and expand firmly against walls of hole to secure definite readings. To expand the device, at any depth, the weight is supported by the wire leads and the handle is used to tap gently the expanding cone, securing high pressure earth contact. To change position the handle is simply lifted up, disengaging the cone and collapsing the electrodes. A regular ground testing instrument may be used, but readings can be better observed and more rapidly taken with an indicating milliampere meter and about 4.5-volt dry battery.

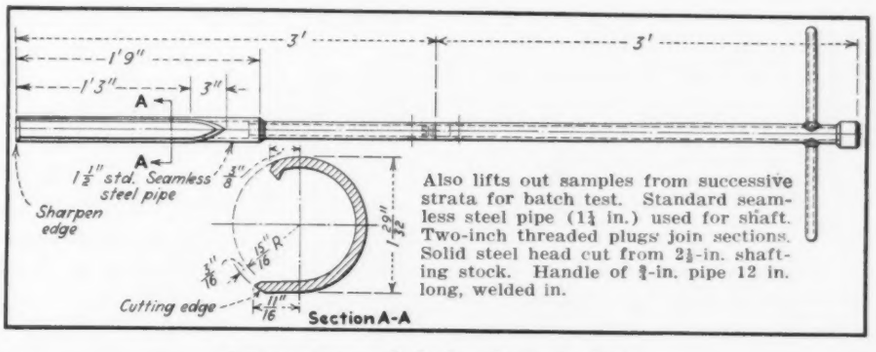
Calibration of the outfit as shown was based on the assumption that the contact resistance was negligible and the resistance of earth in proximity to the test electrodes was uniform. This assumption proved to be nearly correct, as shown by a comparison of the readings in test holes in various kinds of soil as compared with the resistance of 8-ft. test rods.

A test was made to determine the relationship between resistance readings in test holes and the ohms per cubic centimeter of the surrounding earth. This was obtained by mounting similar electrodes on the surface of a long insulating cylinder of same

[*Continued on page 86*]


$\frac{3}{8}$" pipe, bushed to retain bolt head-pipe to slide freely along bolt
Bolt nut to serve as stop for cone.
4 $\frac{1}{2}$"
4"
6 $\frac{1}{2}$"
$\frac{3}{8}$" pipe handle-to slide freely in $\frac{3}{4}$" pipe frame
$\frac{1}{8}$" x $\frac{1}{2}$" spring steel
Connection of lead to copper electrodes
Expanding cone 1$\frac{1}{4}$" x 3$\frac{1}{2}$" long
$\frac{5}{16}$" x 6" mach-bolt.
A
A
1$\frac{5}{8}$"
22 gage sheet copper-electrode
Insulation-rubber cloth and compound
Cone
Flap of sheet copper holding electrode in place
Segment of 1$\frac{1}{4}$" pipe. Paint with insulation paint.
Flaps holding electrodes on frame
Section A-A

Ground test electrodes determine resistivity in single bore
Test hole made 2¼-in. in diameter by auger shown below.



Also lifts out samples from successive strata for batch test. Standard seamless steel pipe (1¼ in.) used for shaft. Two-inch threaded plugs join sections. Solid steel head cut from 2½-in. shafting stock. Handle of ¾-in. pipe 12 in. long, welded in.

Auger prepares hole for electrode device

Farmers Look Askance at Co-operative Lines

Iowa State Planning Board Uncovers the Obstacles to Extensive Engagement in Co-operative Rural Lines—Several Factors Conspire to Dampen Farmer Enthusiasm

IT MAY be possible indeed that the farmers of Madison County, Iowa, are a peculiar lot, vastly different in their attitudes and reactions from all other farmers in the country. Perhaps it is a remarkable condition that these particular agriculturists are reluctant to plunge into the practical problems of rural electrification with the same élan and abandon that the planners exhibit in their treatment of it as a social theory. It is more probable, however, that the opposite is true, that, far from being exceptional, the Madison County people are typical and that investigation would very likely disclose much the same feelings among farmers over the nation.

County survey shows tone

Presented in the following numbered paragraphs are the "Hindrances to Rural Electrification Projects in Madison County in Approximate Order of Importance," as reported after extensive investigation by John Hollen, field engineer, public service division, Iowa State Planning Board. It was proposed that co-operative farm lines should be built to secure energy from the municipal plant in the town of Winterset, the county seat, located about in the center of the county. Some of the obstacles uncovered by Mr. Hollen are specifically local, but the feelings that inspire them are by no means confined to Madison County.

I. *Antagonism Toward Twenty-Year Indebtedness*—In spite of the fact that customers on any rural power line must amortize the cost of the line with their power bills, many farmers are unwilling to co-operate in any twenty-year payment plan or, for that matter, to enter into anything that sounds like further indebtedness just now.

II. *Fear of a Few Members Shouldering Responsibility*—Many farmers fear that a large number of customers may drop out, leaving the payments on principal and interest to fall back on a few.

III. *Fear of Ability to Collect Power Bills*—Due to difficulties in collecting switch fees and toll bills on some of the mutual farm telephone lines, some communities are afraid that the co-operative will not be strict in collecting, and unpaid bills will be carried by the rest of the customers, increasing monthly payments.

IV. *Financial Inability*—Many farmers are trying to rebuild their herds of stock and catch up on unpaid bills which resulted from last year's drought and will not be interested in the program until they are in better shape financially.

V. *Fear of Assessments*—Previous experiences with co-operatives and mutual ventures have convinced some farmers that assessments are coincidental with such, and no end of persuasion will shake their belief.

VI. *Fear That Power Contract Will Not Prevent Future City Councils From Raising Rate Arbitrarily*—An abrupt decrease in the power rate in Winterset followed by an increase by the next Council, and later lowering by the next Council cause some distrust in rural communities.

Unwillingness to add to debt load, antagonism toward relief labor, the Administration and city folks in general, plus fears as to management, non-collection of bills, assessments, political manipulations of rates and possible evasion of financial responsibility by some customers—these, united to a hope that the power companies will build lines in the district, turned Iowa farmer enthusiasm a little sour on co-operative line projects.

VII. *Lack of Definite Information on the Plan*—The fact that we cannot quote actual facts instead of indefinite opinions causes a great deal of reluctance.

VIII. *Hope That Power Companies Will Enter District*—Private utilities have made a few inquiries in the territory and some of the best prospective customers in the district are stalling in the hope that the power companies will build lines; they (some few) feel that the added cost will be compensated for by the satisfaction of having a definite contract and absolute freedom from responsibility.

IX. *Antagonism Toward Use of Relief Labor*—Farmers, in general, feel that they are paying for the relief program and are rabid against all relief work because they were unable to get help on their farms during the past harvest season; they also think that relief labor is overpaid and underworked. The fact that city and county projects receive public works labor free of charge makes many feel that they are being treated unfairly.

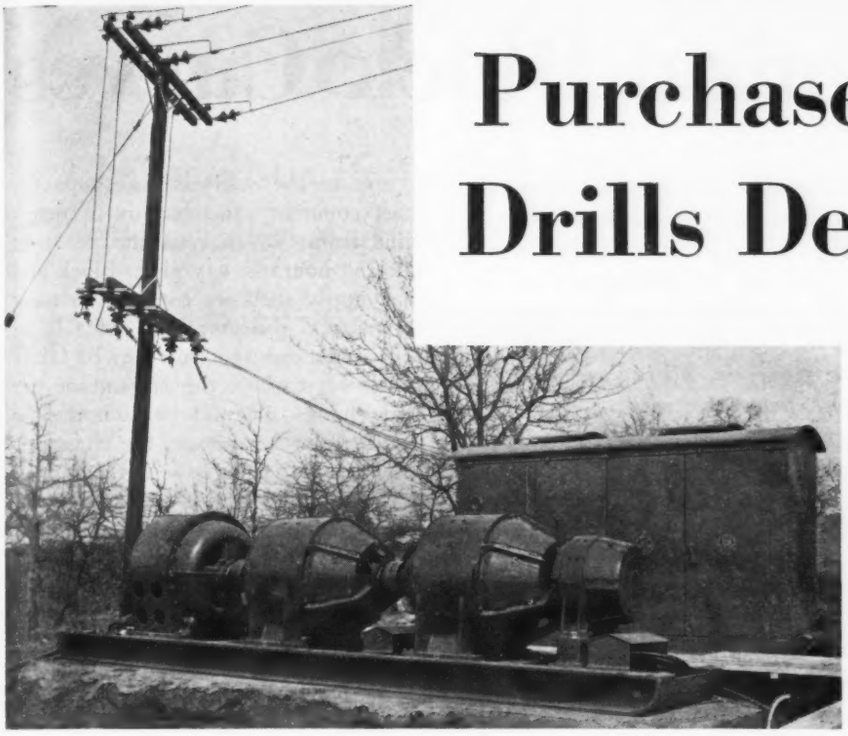
X. *Antagonism Toward Democratic Administration*—A few of the farmers in Madison County are hardheaded enough to stand out against anything sponsored by the present Administration.

XI. *Failure of Previously Planned Lines to Materialize*—Part of the territory surveyed has been previously gone over and customers contracted by power companies on two previous occasions, causing them to be reluctant to go into anything until they see construction start.

XII. *Economic Embargo Against Winterset (County Seat)*—New P.W.A. road surfacing projects seem to have caused some distrust and antagonism in one section of the county; farmers feel that they have been neglected and that Winterset interests have influenced supervisors to surface all roads near the county seat, and, as a result, they boycott the town. Some say that they would not use power from the Winterset plan if it were given to them.

XIII. *Fear That Management and Maintenance Will Not Be Efficient and Satisfactory*—Experience with telephone line maintenance and co-operative creamery and elevator management have convinced many that farm-owned ventures cannot be successful.

Purchased Power Drills Deep for Oil



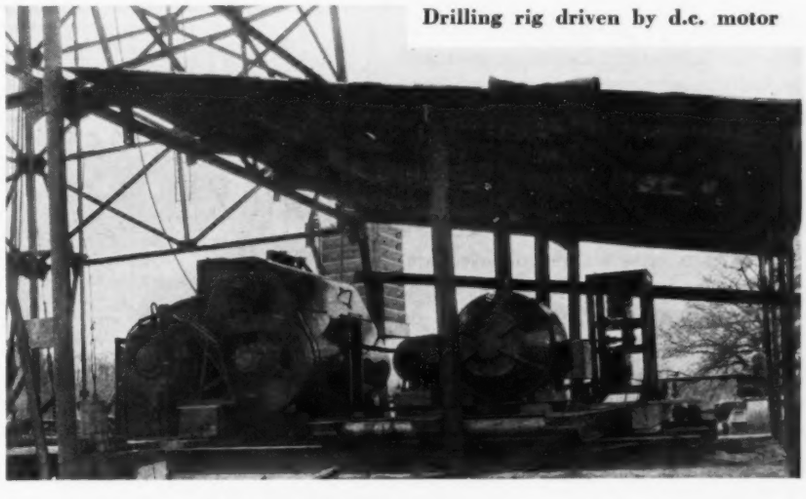
By LEO H. TOWERS
Tulsa, Okla.

OIL WELL drilling is a job in which time between start and finish is measured in weeks. Therefore the economy of power from a supply system, including, as it must, the cost of line extension and possibly voltage transformation, is generally considered to be very hard to prove in comparison with the costs of an oil engine-generator combination that can readily be picked up and carried to the next job as a component part of the driller's rig. Yet, such is the pertinacity of power salesmen and other engineers, efforts have never ceased to make purchased power an economic contender with the oil engine for the job of drilling oil wells. Whether or not these efforts will be wholly successful, or even partly so, in any degree of commercial importance is a matter still shrouded by the veil of the future. But progress is being made, and here is its latest manifestation.

For a well now being sunk in the Binger field, Caddo County, Oklahoma, 10,500 ft. down to the deepest producing sand in the world, the Denver Producing & Refining Company decided to try out an all-electric drilling rig. The electrical equipment assembly was designed, furnished and installed by the Allis-Chalmers Manufacturing Company under the supervision of D. M. McCargar. One of the accompanying pictures shows the motor-generator set mounted on skids which replaces the oil engine generator unit. The main drive a.c. motor is three-phase, 60 cycle, 2,200 volts, 1,200 r.p.m., 400 hp. The two d.c. generators are connected to this motor by flexible couplings. One generator is rated at 240 kw., 350 volts; the other at 150 kw., 350 volts. Also connected on this same shaft is the 25-kw., 125-volt exciter. The generators are self-excited and separately excited. The inclosed control panel can be seen in the rear of the motor-generator set. This equipment is about 125 ft. from the derrick floor.

From the derrick floor the operator, by means of two wheels connected to explosion-proof rheostats, controls the fields in the two generators, thus controlling the operating motors. Under normal drilling conditions the 150-kw. generator supplies the drilling (or draw-works) motor and the 240-kw. generator the mud pumps motor. But when the drill pipe is being pulled from the hole the two generators hooked in parallel supply a maximum of 390 kw. at the draw-works motor.

The draw-works motor is rated at 400 hp. and the mud pumps motor at 275 hp. When in normal drilling operations the draw-works motor uses only about 150 hp. The motors are explosion-proof, ball-bearing type and reduce to a minimum danger from explosive atmosphere found around a drilling well and any trouble caused by the presence of sand. Each motor is cooled by a separate motor-driven fan independently operated from the exciter circuit. The fan intake has a pipe connection to reach beyond the gaseous atmosphere near the well, bringing in clear air from a distance. In addition to the two main motors a group of small motors are connected through the panelboard to operate such auxiliary equipment as wash-down pump, shale shaker and blower.



Drilling rig driven by d.c. motor

Consumption Block Curves

Breaking down data from billing records can be laborious. Short cuts are desirable but risky unless well founded mathematically. Here is a method by which it is possible to estimate with considerable accuracy the number of kilowatt-hours of residence consumption in the various price blocks of the residence rate. This method is simple in practice. It requires a minimum of data, usually available from the billing records, and therefore eliminates most of the expense and labor of making detailed consumption analyses.

By E. S. ZUCK

United Gas Improvement Company, Philadelphia, Pa.

A CONSUMPTION analysis—sometimes called consumer or bill analysis—is prepared by counting the number of bills for each consumption amount. A tabulation is then set up which usually has five columns:

1. Consumption amount.
2. Number of bills for each consumption amount.
3. Number of kilowatt-hours or M cubic feet for each consumption amount (number of bills times consumption amount).
4. Cumulative number of bills for each consumption amount.
5. Cumulative number of kilowatt-hours or M cubic feet for each consumption amount.

In preparing the consumption analysis, it is customary to proceed by steps of 1 kw.-hr. for electric and 100 cu.ft. for gas. The analysis may, however, be set up by steps of 5 or 10 kw.-hr. and 500 or 1,000 cu.ft. of gas. This decreases the number of steps, but does not change the labor in determining the number of kilowatt-hours or M cubic feet in the various steps. Analyses are prepared by both "hand methods and by machines. In the machine-made analysis cards are punched for individual consumptions, one card usually carrying twelve months' consumption for an individual customer. These cards are then sorted and tabulated by machines specially designed for such work. The cost of making a consumption analysis is considerable, involving as it does a large amount of detail work, whether the analysis be hand made or machine made. Where a very large number of accounts must be analyzed the machine method appears to be cheaper as well as more accurate.

In all cases the analysis should cover a full twelve-month period, as otherwise serious error may result in the effort to adjust or average to a full twelve-month period. A useful by-product of a machine analysis is a "customer" analysis, which is an analysis according to the amount of kilowatt-hours or gas used by each customer for the entire twelve-month period. Such an analysis shows how many customers used, in the twelve-month period, say, 100 or 200 or 500 kw.-hr.

Search for short cuts

Since the cost of making an analysis is considerable, it is natural that this expense be avoided as much as possible. Once an analysis is made it is expected "to do" as long as possible, even though it is known that average consumption has changed—usually has increased. Various methods are used to adjust the new total consumption figures to the analysis. Perhaps the most common procedure is to determine from the analysis the per cent kilowatt-hours in any given block and then apply that per cent to the most recent total consumption. This is, of course, not accurate, but may be fairly satisfactory where the amount or per cent change of total consumption is small. When, however, the change is considerable, probably more than 10 per cent, a new analysis may be necessary or advisable.

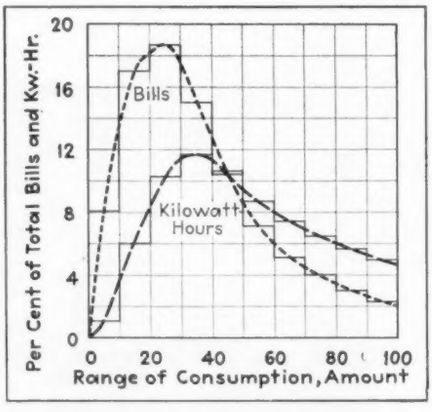


Fig. 1—Bill and kw.-hr. frequencies are skewed probability curves

Efforts have been made also in the direction of decreasing the work involved in making an analysis and thus decreasing the cost. A common practice has been to make an analysis for an average month. It has been found, however, that this introduces serious error, because it does not cover the high bills which occur during the months of maximum consumption, nor the low bills which occur during the months of minimum consumption. In other words, it ignores the fact that two series of numbers, although having the same arithmetical average, may differ widely in the dispersion of the two series. Other methods resort to "spot checking" and the construction or estimating of an analysis from data obtained from other analyses.*

The consumption analysis is used principally in connection with studies of rates for residence service, but may be used for other classes of business, such as commercial lighting, where block rates are under consideration. The consumption analysis may also be used with supplementary data for other forms of residence rates, such as area, room and customer charge rates, where the energy charge is blocked. The most common use of the consumption analysis is that of calculating the effect on revenue of proposed rate changes. It permits the rate engineer to break down the total consumption of all customers into the amounts of kilowatt-hours or M cubic feet which would be billed at the various prices of present and proposed rates. In other words, by means of the consumption analysis the rate engineer can produce mass billing of the total consumption of all customers as contrasted with the

*See "Ready-Made Consumer Analyses," by James J. Hanks, *Journal of Land and Public Utility Economics*, August, 1934.

Converted to Straight Lines

Characteristic Probability Curves of Consumption Frequency When Converted to Straight Lines Facilitate Rate Studies

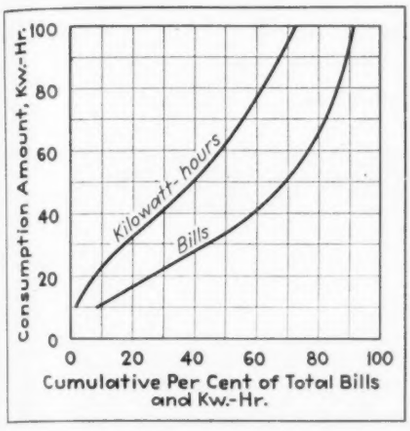


Fig. 2—Cumulative consumption curves are probability ogives

prohibitive labor of calculating individual customers' bills.

After the analysis has been obtained the rate engineer, having set up a number of proposed rates, next proceeds to "block" the analysis according to the present rate and the proposed rates so that the effect on revenue of the proposed rates may be determined. Where a large variety of proposed rates is being studied it may be advisable to set up a blocking that proceeds by small steps, say 5 or 10 kw.-hr. This will require a longer tabulation at the outset, but will save time later as additional rates are studied. If only one or two proposed rates are under consideration, then the blocking may be shortened to cover only the blocks required by these particular rates. The manner of blocking depends on the form of rate. A block rate with minimum charge requires a different blocking for the initial steps than a concealed customer charge or a regular customer charge form of rate. Table I shows a typical analysis in condensed form with consumption amounts ranging from 0 to 100 by steps of 10. The actual analysis was prepared by steps of 1 kw.-hr. In order to show how this analysis would be blocked two examples, each relating to a particular form of rate, are given in the accompanying tables.

The calculation of revenue, once having ascertained the number of kilowatt-hours falling in the various price blocks of the rates, is so simple as to require no further explanation.

Characteristic skewed frequency curves

An analysis appears on the face of it to be merely a collection of figures which if compared with some other analysis shows no apparent relation or similarity. In fact, an analysis is really a frequency table which shows the frequency of occurrence of the various consumption amounts. Table II shows an analysis where instead of using the actual figures of bills and kilowatt-hours (they are usually quite large) the per cent of total bills and total consumption is shown for each range of consumption amount.

It will be observed that for each range of 10 beginning at the range 0 to 10 the percentage of both bills and kilowatt-hours increases to a maximum and then decreases, the maximum being 18.66 per cent of total bills for the range 21 to 30 and 11.65 per cent of total kilowatt-hours for the range 31 to 40. If the per cent values of bills and kilowatt-hours in Table II be plotted as shown in Fig. 1 curves of the frequency type are the result. It will be noted that the curves are not symmetrical, but are skewed, a fact that will be referred to later in this article.

The analysis in Table II also shows

Table III—Consumption Expressed in Billing Blocks

Billing Blocks Kw.-Hr. *	Per Cent of Total Kw.-Hr. Block	Cumulative
0-10	20.91	20.91
11-20	18.32	39.23
21-30	14.39	53.62
31-40	10.69	64.31
41-50	7.78	72.09
51-60	5.81	77.90
61-70	4.45	82.35
71-80	3.42	85.77
81-90	2.67	88.44
91-100	2.07	90.51
Over 100	9.49	100.00

*If a gas analysis is under consideration the billing blocks would be expressed as from 1 to 10 M cu. ft. instead of 10 to 100 Kw.-Hr.

Table I—Typical Blocking of Residence Consumptions

Range of Kw.-Hr. Consumption	Number of Bills	Number of Kw-Hr.	Cumulative No. of Bills	Cumulative No. of Kw.-Hr.
0-10	2,819	18,446	2,819	18,446
11-20	5,221	81,318	8,040	99,764
21-30	4,486	113,091	12,526	212,855
31-40	2,975	104,265	15,501	317,120
41-50	1,910	86,056	17,411	403,176
51-60	1,112	61,474	18,523	464,650
61-70	811	53,097	19,334	517,747
71-80	547	41,250	19,881	558,997
81-90	462	39,530	20,343	598,527
91-100	354	33,730	20,697	632,257
Over 100	2,220	423,557	22,917	1,055,814

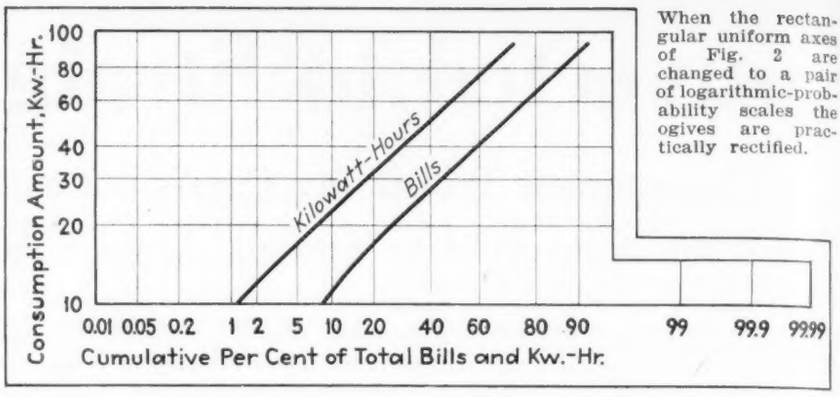
Table II—Consumption Frequency in Percentage Form

Range of Consumption Amount	Per Cent of Total Bills	Per Cent of Total Kw.-Hr.	Cumulative Per Cent of Total Bills	Cumulative Per Cent of Total Kw.-Hr.
From 0 to 10	8.16	1.18	8.16	1.18
From 11 to 20	17.16	5.98	25.32	7.16
From 21 to 30	18.66	10.37	43.98	17.53
From 31 to 40	15.18	11.65	59.16	29.18
From 41 to 50	10.64	10.45	69.80	39.63
From 51 to 60	7.27	8.69	77.07	48.32
From 61 to 70	5.22	7.37	82.29	55.69
From 71 to 80	3.99	6.46	86.28	62.15
From 81 to 90	3.07	5.65	89.35	67.80
From 91 to 100	2.38	4.90	91.73	72.70
Over 100	8.27	27.30	100.00	100.00

cumulative per cent of total bills and kilowatt-hours. These cumulative per cent values are plotted in Fig. 2 on rectangular co-ordinates and result in entirely different curves, which are known mathematically as the ogive. These curves are shown in order to contrast them with the same data plotted later on different co-ordinates.

Skewed curves rectified

Since the analysis shown by Table II constitutes a frequency table, it is apparent that to some degree it should follow the law of frequency. This can be determined most readily by plotting the data of Table II to a scale which is calculated from the theoretical frequency law. The theoretical frequency curve plots on such a scale as a straight line, and therefore if the data in Table II follow the frequency law the curves shown in Fig. 2 on rectangular co-ordinates should be straightened, the degree of rectification depending on how closely the analysis follows the theoretical frequency law. Fig. 3 shows the cumulative per cent of total bills and total kilowatt-hours plotted to a horizontal scale determined from the theoretical frequency curve, while the vertical scale is logarithmic, partly for convenience, but largely because the curves under consideration are skewed frequency curves. The curves in Fig. 3 show a marked degree of straightening; in fact, from 20 to 100 they are straight lines, only the point at 10 being out of line. This is, however, not always the case. Sometimes these curves are straight for a middle section from 20 to 60 or 80, and from these higher values up to 100 deviate from straight lines, curving either to the right or the left.

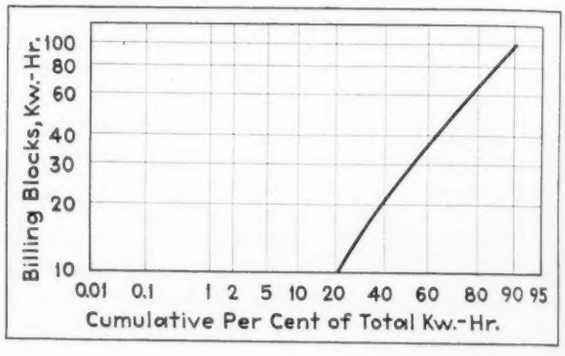


When the rectangular uniform axes of Fig. 2 are changed to a pair of logarithmic-probability scales the ogives are practically rectified.

Fig. 3—Consumption ogive becomes nearly linear

Fig. 4—Cumulative consumption curve also nearly linear

The same logarithmic - probability paper of Fig. 3 affords the facility of locating the line by 2 or 3 points instead of the 10 or 12 required in Fig. 2.



The next step has to do with the billing blocks. It has been shown previously how the rate engineer blocks the analysis so as to determine the number of kilowatt-hours falling in each price step of the rate. If the analysis shown in Table II be blocked so as to proceed by billing blocks of 10 kw.-hr. up to 100, the results are as appear in Table III.

In Table III the figures are derived from the data of the analysis represented in per cents in Table II and plotted in Fig. 3. It has been shown that both cumulative per cent bills and kilowatt-hours follow closely the frequency law. Therefore the cumulative values in Table III should also follow the same law. In Fig. 4 the data of Table III are plotted to the same scales used in Fig. 3. Again the curve is nearly a straight line, in this case showing somewhat more deviation at the lower portion than the curves of Fig. 3. This curve, *i.e.*, Fig. 4, is particularly useful to the rate engineer, since it expresses the analysis in the most convenient form from which can readily be found any desired blocking.

A subsequent article will show how this technique can be applied to yearly comparisons and to projected results.

Example 1

First 20 Kw.-hr. at 10 cents per Kw.-hr.
Next 30 Kw.-hr. at 5 cents per Kw.-hr.
All over 50 Kw.-hr. at 3 cents per Kw.-hr.
Minimum charge $1.00

Consumption Range	Bills	Kw.-Hr.	Kilowatt-Hours in Minimums	First 20	Next 30	Over 50
0-10	2,819	18,446	18,446	.....	.....	.....
11-20	5,221	81,318	.....	81,318	.....	.....
21-50	9,371	303,412	.....	187,420	115,992	.....
Over 50	5,506	652,638	.....	110,120	165,180	377,338
Total	22,917	1,055,814	18,446	378,858	281,172	377,338
						281,172
						378,858
						18,446
						1,055,814

Example 2

First 10 Kw.-hr. or less $1.00 minimum bill
Next 40 Kw.-hr. or less at 5 cents per Kw. hr.
All over 50 at 3 cents per Kw.-hr.

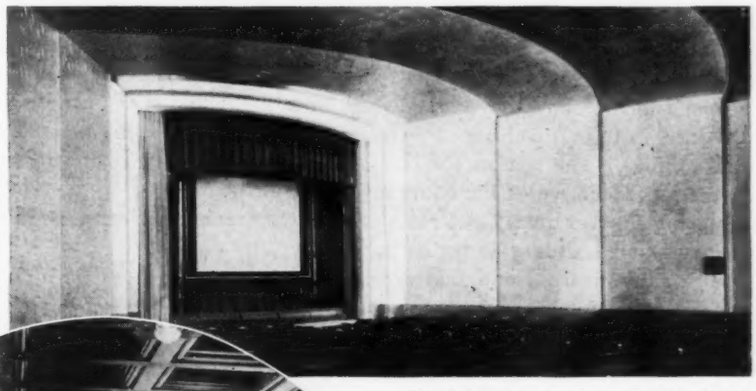
Consumption Range	Bills	Kw.-Hr.	Kilowatt-Hours in First 10	Next 40	Over 50
0-10	2,819	18,446	18,446	.....	.....
11-50	14,592	384,730	145,920	238,810	.....
Over 50	5,506	652,638	55,060	220,240	377,338
Total	22,917	1,055,814	219,426	459,050	377,338
					459,050
					219,426
					1,055,814

Lighting and the Normandie

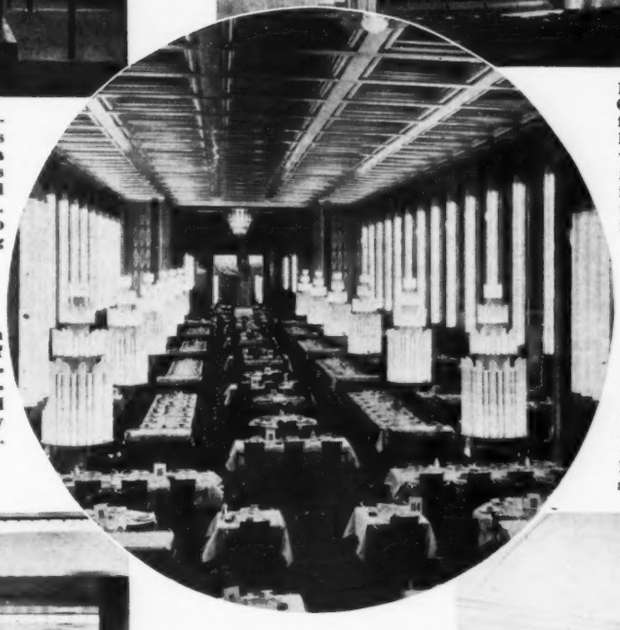
By **OSCAR P. CLEAVER**
Illuminating Engineer,
Westinghouse Lamp Company,
Bloomfield, N. J.

LIGHTING on the *Normandie* serves equally the arts of illumination and decoration. Glass, translucent marble, richly colored woods and metal are used extensively and with telling effect in the direct and indirect lighting fixtures to produce evenly distributed illumination in public rooms and corridors. Unshielded lamps, bright luminous wall decorations and extremes in intensities have been carefully avoided. Coves and indirect fixtures which are widely used have been carefully designed and lamps properly placed to produce uniform illumination. Decorative glass in its sculptured, fluted and opal form is lavishly used for combined lighting and artistry.

Grand Salon has luminous wall decorations. Lighted pylons of fluted glass and urn-type indirect units produce a majestic effect. Walls entirely of glass surround the room and are decorated with pictures of the ships of all ages. Wall fixtures in the foreground also house ventilating and air-conditioning outlets.

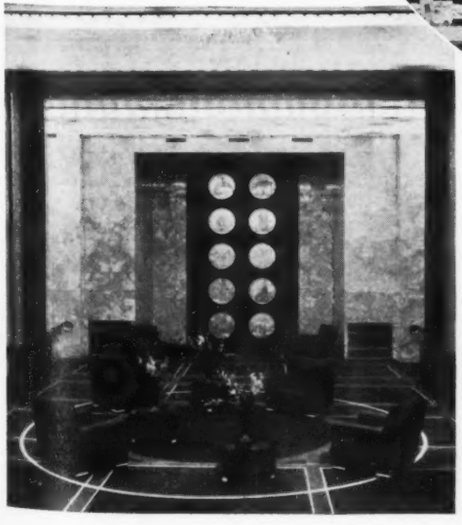


Reminiscent of New York's Radio City Music Hall is the theater, entered from the foyer. Walls and ceiling have a metallic tone and are decorated with a design of modern figures "engraved" in the surface. Cove light intensity increases gradually from rear to the front of the auditorium, climaxing at the stage to hold attention there.

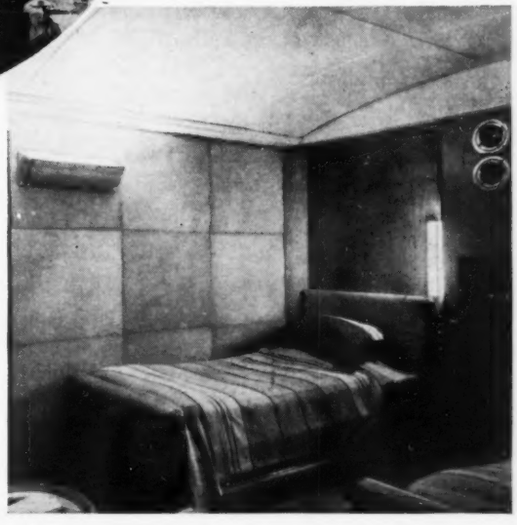


Effect of tall windows is created in the Grand Dining Salon by use of luminous glass columns. Supplementing these are a series of fountain-like floor fixtures of fluted glass. The average light intensity in the salon is about 10 ft.-candles.

Simplicity of suites contrasts with the ornate decoration of public rooms. Simple opal glass panels in the ceiling and at the head of beds and around dressing tables predominate. Indirect lighting from simple wall troughs is also provided.



Photos courtesy French Line



First-Class Foyer—Devoted to an artery or public rendezvous. Rectangular boxes of amber tinted glass, lighted from within by 2,396 15-watt lamps, are placed end to end and side by side to cover nearly the whole ceiling. Illumination of 15-ft. candles is obtained which has the quality of indirect light.

As One Merchandiser to

Load Should Be Built by Merchandising, but How Much and How Fast? Here Is a Method of Attack on the Load-Building Job That Is Logical, Practical and, in Spots, Surprising

PRESUMABLY every head of a utility sales department is competent and capable in the job of selling electrical appliances to the great American public. However, in spite of the capacity of their directing heads a lot of so-called merchandising departments are just making motions that perhaps are effective in keeping a few men in their jobs, but otherwise mean nothing. The reason for this is that the top executive of the company, the big boss, never really got religion so far as load building is concerned. He must be converted and this is the other side of the sales executive's job. And very probably he will find it harder work to sell his merchandising plans to his boss than to sell merchandise to the public.

There are a lot of things about merchandising that the sales head seldom bothers his volatile brain about, but which must be given careful consideration by the top executive. In the boss' mind are these thoughts: Fear of large merchandising losses and of the damaging inferences that can easily be drawn from them by unfriendly critics; the belief that operating expenses are increased because of merchandising and the fact that operating ratio is a measure of managerial ability; the inclination to discount sales figures because of the enthusiasm of salesmen; no real proof that the load is being, will be or may be added by merchandising is profitable; the final inevitability of the load anyway, because, if they are worth while, people will buy electric appliances and will not require that they be sold to them; the effect a merchandising program with considerable investment in stock, promotion and personnel might have upon the cash position of the company. And, finally, no one has ever stated to him in a convincing manner, much less proved, the effect of merchandising on net earnings.

As a result of his equivocal, "show me" attitude the boss' support of merchandising is not wholehearted. He rallies round when things are going good, but falls away rapidly when the weather clouds up. Or his enthusiasm is only spotty; that is, he believes in some aspects of merchandising but not in others. Or perhaps he just tolerates merchandising because everybody else seems to be all worked up about it, and he is just trying to copper the bet. Or maybe he asks for the impossible. Maybe he wants a combination of rapid load building and real honest-to-gosh merchandising profit.

Most probably the reason for lack of merchandising enthusiasm on the part of the utility executive is due to the fact that you can't have enthusiasm without faith to build it on. The average utility executive through late experience has little faith in the beneficence of Providence. On the contrary, he knows he is going to bear increased taxes and must pay them out of the income from lower rates. In spite of this he must satisfy the stockholders, who are his bosses, with increased net earnings, which can only come from increased gross income, which requires increased consumption from present users of electricity. Therefore the sales head must furnish the boss a faith on which load building enthusiasm can rest.

To put it in very blunt words, the boss is in a hell of a picklement. Now, if we in the merchandising end of the business will give him something more than large promises and bright smiles, if we will prove to him that merchandising will actually help him out of his picklement we will gain his confidence, earn his respect and receive his enthusiastic support.

This is the other side of our job, to prove to the boss that we know what we are doing and can do it. It requires that we collect, study and analyze the facts of merchandising. And that is not all. Just as important, we must present these facts in a way that will convince him of their integrity. Specifically, we must convince the boss that our merchandising program will increase the net revenue of the company and we must say definitely when that increase can be expected and how much it will be.

The first step in establishing the true cost of producing revenue from domestic load building is to determine

The Rate of Return on a Load Builder

None of the figures in this example refer to any appliance nor to any system. They are entirely arbitrary and their only purpose is to serve as a convenience in following the analysis through. Substitute your local figures in this calculation to get your local answer.

Estimated Annual Use, Kw.-hr.	Rate	E A R	Capacity to Be Replaced, Watts	Cost of New Capacity at $200 per Kw.
2,000	2	40	1200	$240
Retirement provision, 2% of $240				4.80
Taxes, 1% of $240				2.40
Production cost of power, 2,000 kw.-hr. at 0.005				10.00
Added Expense per Kw.-hr. of Additional Generation				
Conversion —a Transmission—b Distribution —c Utilization —d	cents per kw.-hr. $0.0005 per Kw.-hr. x 2,000			1.00
Additional expenses which are estimated in percentage of additional gross revenue—				
Commercial expense a Provision for bad debts b General expense c	per cent 1.2%x$40			0.48
Load Building Cost—50 cents per dollar of Increased Gross				$20.00
(Includes all charges to new-business expense which originate in merchandising plus merchandise loss, plus interest on merchandise accounts receivable and merchandise inventories)				
Total—All of above costs				$38.68
Balance available for interest and dividends $40—$38.68				1.32
Rate of return—first year ($1.32—$240)				0.55
Cost to furnish and serve load during second year ($38.68—20)				$18.68
Revenue during second year				$40.00
Amount available for interest and dividends during second year ($40—$18.68)				21.32
Rate of return ($21.32÷$240) per cent				8.99

Another

By V. H. MOON

Commercial and New-Business Manager,
Middle West Service Company,
Chicago, Ill.

accurately the figures to be used in estimating annual revenue from load-building appliances. In spite of the criticism by various and sundry of "estimated annual revenue as a validly determinable factor in the merchandising equation, the fact still remains that if any quantitative solution of the merchandising problem is to be reached some figure of estimated annual revenue must be used. Therefore the merchandising head of a particular company should be certain that his figures for estimated annual revenue really apply in his local picture, because national averages positively will not do. He must make allowance for the fact that some of his sales will have no load-building effect at all because they are merely the replacement of existing appliances. He must realize that improvements in the appliances themselves have progressively lowered operating costs. He must anticipate rate reductions that are in the immediate offing or recognize the automatic rate reductions that usually apply when energy consumption is largely increased. And he can't acquire the basic information on which these considerations are erected without making actual field checks of appliance operation in his territory.

The final step in all this research and analysis is a simple problem in multiplication for each load-building appliance—so many annual kilowatt-hours at such an average rate. The result will be E A R (estimated annual revenue) and its validity will be in direct proportion to the intelligence and care used in its determination.

Now having established the value of load building, it is time to consider how much it will cost. No matter how accountants may define it, true load-building cost is the increment cost of merchandising; that is, the actual added cost above that of operating the system without merchandising. But the calculation is not simple subtraction between operating costs with and without merchandising, because in a given system the two total costs cannot exist simultaneously, and unless they are simultaneous they cannot accurately enter into the calculation. Therefore the accretion of cost due to merchandising cannot be determined in total and must be the sum of detail separations that are practical to handle. The difficulty in this method is that it is so easy to overlook items that should be included.

First off, there should be a thorough analysis of the classified accounts to determine how many costs really chargeable to new business and other functions are included in merchandising accounts and how much should properly be taken from new business and others and charged to merchandising. For instance, certain advertising may be charged to merchandising because merchandising copy appears in it, but in the mind of the sales executives may not represent real selling value. Conversely, it frequently happens that merchandising executives are more than willing to let certain items of their costs be hidden in other accounts so that their showing will be better. Uniform classifications of accounts prescribed for regulatory purposes are legally proper for those purposes, but at best they are compromises with business realism, and it is the realities of business that we are discussing here. So the merchandising executive who wants to do his job right will allow neither his costs to be saddled on other accounts nor other costs to be pushed onto his.

A class of costs that often is not included in merchandising expense is of money employed in financing sales and maintaining stocks of goods. This money is thus prevented from earning return in other fields and therefore interest on it is a proper merchandising cost.

In the allocations of shares of expenses that are joint with other utility functions the merchandising executive should be careful to see that his apportionments are truly justified. Public office space in which a few appliances are displayed should not be charged to merchandising if that same space would have been provided anyway as a customer lobby. Nor should merchandising bear the warehousing charges for space in garages or other buildings that happen to be available for appliance stocks. The propriety of these charges in prescribed account classifications is not at all in question. But we are concerned here with the actual cost of merchandising, which, as earlier stated, is the increment cost over system operating expense. And no one can say that anything is added to operating expense by storing a few appliances in the vacant corner of a basement.

What revenue will it buy?

Now having found out what it is, the cost of load building must be compared with the net revenue it will buy. Proof must be given that the gross revenue proposed to be added does actually contain net income. How much and when. The cost of serving this new load must now be considered.

The cost of serving any load is made up of many factors, some of them not plainly apparent. Consider an existing system with capacity adequate for its load and earning a return satisfactory in relation to money invested and not excessive from the regulatory viewpoint. New load added to this system may disturb the existing nice balance in two ways. If the accession of the new load is not accompanied or followed in reasonable time by corresponding new capacity added to the system, operating conditions will be changed for the worse. If the new load does not earn on the cost of the new capacity a rate at least equal to the rate being earned on the investment in present capacity there will be a decrease in the over-all system return rate and the new load will be a loss maker.

Note that the new load is required to earn on the cost of new capacity, not on the investment in present capacity. There is a difference here that the acute sales executive will insist upon since new capacity usually will cost

[*Continued on page 68*]

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L. W. W. MORROW · EDITOR

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N.E.M.A. Turns to Marketing

THE most constructive development in the electrical industry is the rapid strides N.E.M.A. is making toward industry leadership in organized sales and sales promotion. At the convention in New York last week C. E. Swartzbaugh made a report for the business development committee that was astounding and epochal.

A positive organization and mechanism has been set up and has gone into action. An inter-industry relations committee has been established that contains the top executives of the four major branches of the industry—a working tool for joint action and a common policy. N.E.M.A. has taken membership in the Producers' Council so as to get a direct approach to architects and builders to give them electrical business plans and information. The 90 local electrical leagues have been organized into an association that can and will co-operate in business getting. Several of these leagues have already started co-operative work with electrical maintenance engineering groups. A preliminary planning committee is at work to secure and promote a plan for adequate wiring that the industry will accept and put to work. In the N.E.M.A. sections sales projects on welding, domestic appliances, street lighting, industrial furnaces, conduit fittings and switchbox and outlets are under way to get more business and to improve marketing. The joint activity on national kitchen modernization has been strengthened and broadened.

So marked has been the progress that N.E.M.A. approved a new bureau form of organization to promote these marketing activities. Six bureaus—residential, commercial, industrial, utility, farm and governmental—have been established to afford a working basis for the new sales activities.

We have said many times that N.E.M.A. is in best position to take this responsibility in marketing, and the enthusiastic leadership of Mr. Swartzbaugh, with the able assistance of his committee, has brought results. Every possible aid and support should be given to this movement by individual electrical manufacturers and by the other groups in the electrical industry. In our opinion N.E.M.A. has taken a position in marketing that promises to be its salvation as an organization. Beyond this it has chosen work of maximum value to the entire industry. It is the basis of business progress and industry prosperity.

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Electricity and Death

ELECTRICITY, numerically one of the less important causes of fatal injury, was, nevertheless, responsible during 1934 for more than 700 deaths in the United States. Of these, according to figures of the Metropolitan Life Insurance Company, about 50 per cent occurred as a result of injuries arising out of or in connection with employment. From these figures it becomes at once apparent that any reduction in the death rate from electricity will depend upon efforts to educate not only electrical employees but the public generally in the essentials of safety.

Safety campaigns conducted among employees of utility companies and in other industries have already resulted in saving a great many lives, as is indicated by the fact that the ratio of occupational to total electrical fatalities has fallen from 80 to 50 per cent from 1930 to 1934. But safety campaigns within the industry are not enough in themselves. These campaigns must be extended to include the public generally. Public safety demonstrations in which utility employees participate will go far toward making the employees themselves, as well as the public, safety conscious.

The electrical industry must continue the safety campaigns among their employees with unrelenting vigor, but they should be, and logically are, the agents for public education on the subject of safe use of electricity. By acting in this capacity they will earn and deserve the good will of their customers.

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Distance Limits in Transmission

INTEREST in long-distance power transmission has revived and the article by H. H. Skilling in this issue is timely and informative. It is apparent that almost no technical limits exist to the distance to which electric power may be transmitted. As a consequence a widespread idea prevails of a far-flung grid of transmission lines joining widely spaced large power stations as the future type of power supply for this country. The technical aspects and magnitude of such a vision is attractive to contemplate.

But power supply is not only a technical problem. It is also an economic and service problem. And when one puts down the dollars and the requirements for continuous service the grid scheme becomes an appalling

handicap to an abundant and inexpensive power supply in this country. Year after year the economic and service continuity criteria on power supply have brought the transmission distance closer and closer to the load. To get the full values out of power produced at the load is a sounder principle to follow than the conception or building of a super-power grid.

Each year witnesses cost reductions and improvements in fuel-power plants that far exceed any similar developments in transmission and distribution. There is a continual advance in the requirements for continuity of service that adds cost and complexity to the endeavor to send power to any distance. Our future power supply, if it conforms to facts, will consist of a multitude of relatively small power stations feeding local load areas.

But every endeavor should be made to bring into this picture the distant hydro power as an added source of power. To do this, however, necessitates a cost reduction and a performance improvement in transmission, because otherwise it is cheaper to install and carry local capacity and local reserves. It is in this realm that the ideas of Mr. Skilling fit. For the present overhead standard lightning-proof line there seems to be little in store in the way of lower cost or better service. This is why it is wise to encourage the developments in the oil-filled cable, the oil pressure pipe line and the air or gas pressure pipe line. All these give promise of lower costs and improved performance and their development may make it possible to obtain greater economies in transmission.

In the same category is d.c. transmission. Trial installations should be made and experimentation and development encouraged, for ultimately this may afford opportunities to reduce costs and improve performance. At present, however, it is not a threatening economic bomb because of the costs and complexities involved. Thus, a survey of the art and the economics of power supply puts into the distant future any threat to end the present trend toward decentralization involving both the generation and supply of power in local areas.

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Fault Distortion Relaying

WHEN the word "neat" is applied to a matter of technique it means just about what the symmetrical component analysis developed by Fortescue is. It is at once unique and comprehensive in its disclosure of upset equilibrium in an otherwise tranquil system. That being the case, as far as the engineering analysis is concerned it is remarkable that relatively little has been done to incorporate the principles in equipment which will likewise detect the existence of a fault and proceed automatically to segregate it or control it. In brief, we have symmetrical component analysis, so why do we not frame our protection schemes upon symmetrical component relaying?

Pointing out this mutual exclusiveness of theory and practice implies no disparagement of existing relaying technique. Nor does it overlook the fact that the networks already devised to "sort out" the positive, negative and zero sequence components might constitute somewhat a handicap in that they pool all line and load dissymmetries and all fault conditions into one composite index. The very embraciveness of the result may therefore prove a deterrent to as wide an application in apparatus as on paper. Nevertheless, this is not insuperable and we may yet see ideal relaying which is actuated by the segregated components that reveal undesirable dissymmetry.

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Revive the Program for Power Sales Handbook

NOT a small part of intelligent power selling rests in knowing something about the industry in which one hopes to clinch the virtues of the electrical way. Knowing about the process requirements in industry places the power missionary in a favorable psychological position to talk the language of the particular establishment which he is trying to interest. That realization has actuated a few utilities, but with one or two exceptions the task of educating power sales staffs about industrial processes has not progressed very far. In fact, it is a somewhat expensive undertaking and becomes prohibitively so if every company proceeds to do it on its own. Many companies preparing data for the same industries at the same time would clog the channels of information. The job is an industry-wide job and should be made one of co-operative action.

Three issues back ELECTRICAL WORLD started publication of a series of data sheets for the bakery industry and it was announced that the series would continue with laundries and other widespread users of electrical equipment and methods. Thanks to the generous collaboration of American Water Works & Electric Company, and especially of Messrs. Finlay and Fuller, we are enabled to carry out that promise. Access has been afforded to the comprehensive studies they have made of product flow through the processes of a wide variety of industries. It is firmly believed that power sales executives will see the benefits of this series and that it will stimulate a revival of the program to build up a live and always timely compendium of industrial technique that shows where electricity fits best and, therefore, first.

Reactions to this program have already been most encouraging and the power sales field is indebted to these officials for making available the initiating contributions in this series. As others feel impelled to make similar analyses, the series will be expanded. It is our hope that out of it will come an aggressive program toward recording the peculiar needs of all industries for the aid that electrification can afford in making their products better and cheaper.

Taxes Worry New Deal

PENDING decision of the Supreme Court as to just how far Uncle Sam can go in the private business field, which is hoped for, though may not necessarily come, in the T.V.A. decision, the high court has shown a strong tendency to insist that when governments go into business they become business men—and must act accordingly. Among other things, unless specifically exempted, they must pay taxes.

Two decisions by the Supreme Court, not given a great deal of publicity, show this tendency. One forced a federal agency to pay local taxes. Another forced a local agency to pay federal taxes. The R.F.C. was compelled to pay Pennsylvania state taxes on the preferred stock of banks in Pennsylvania. R.F.C. had bought this stock and insisted that because it was a federal agency it could not be taxed by Pennsylvania. But the court held otherwise.

Pennsylvania's liquor commission, a state monopoly, was forced to pay not only the regular stamp and excise taxes on liquor, but corporation income taxes on the profits! In short, the Pennsylvania Liquor Commission was regarded by the court precisely as though it were a private corporation doing business in Pennsylvania. And the R.F.C. was regarded by the court just as though it were a private investor.

What makes these decisions of such tremendous importance at the moment is that they run flatly contrary to the tendency shown during the last few years by Congress—not only since the New Deal came into power, but even in the few years preceding.

FOR example, Congress in writing a revenue law during the Hoover Administration imposed a tax on gas and electric bills. But it specifically exempted municipally or governmentally owned plants. At that time the tax item appeared on the bills. The following year Congress changed the law, forcing the private utilities to absorb this tax, but continuing the exemption for publicly owned utilities.

Now neither this original tax, with its exemption for governmentally owned plants, nor the change, forcing private companies to absorb the tax, were just slipped through. They occasioned a great deal of debate. A senatorial primary in Georgia is alleged to have turned on this issue. Certainly the defeated candidate was charged with having favored the private companies in permitting them to add the tax to the bills submitted customers.

But *no* issue was made, then or since, on exempting publicly owned utilities from this tax. And this despite the fact that this exemption amounts to taxing people in one community and exempting people in another. Which issue, in view of the recent Supreme Court governmental tax decisions, might produce another pivotal case for the high court to decide. Especially in view of some of the pretty plain language of the A.A.A. decision, language which convinced Senator Borah, for example, that the Townsend plan would be held unconstitutional if enacted.

During the debate which ended in a vote to force the private utilities to absorb this tax, Senator Logan pointed out that this tax would have to be considered by the public utility commissions of the various states in fixing rates, and therefore Congress was not really doing such a favor for the consumers. But his argument was brushed aside by the majority. Senator Norris retorted that although the point was well taken if a long period of time were considered, there was always a lag, and that during this lag the consumers would benefit!

The mere fact that Senator Norris thought in tune with the Roosevelt ideas about utilities then is not surprising. The interesting part is that Congress voted to penalize the utilities during this expected lag period, and was not concerned about the injustice done *after* the lag period to citizens living in communities served by private utilities.

THE question which may now be presented to the Supreme Court, in view of the recent decisions, is whether, under the constitution, Congress has the right to use the taxing power to force citizens to substitute publicly owned for privately owned utilities.

Actually most of the interest in this question lies not in this injustice in taxation as between communities, because concealed taxes do not provoke much outcry from the people paying them, as a rule. People are rather patient, anyhow. Even about taxes, if one excepts the French.

But the tax problem will be more important, by far, long before it becomes less important. For taxes are going to grow. They already amount to around $17,000,000,000 a year, $8,000,000,000 federal and about $9,000,000,000 local. Hence taxes become a tremendous part of the cost of conducting any business. And the exemption of any line of business throws a more crushing burden on the others.

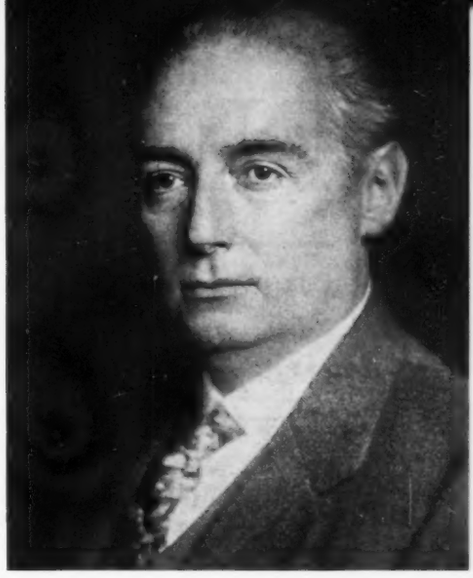
Moreover, the weight of taxes is being realized more in the last few years. In fact, had it not been for taxes the extreme probability is the prohibition amendment would never have been repealed.

It is the much-talked about yardstick, however, which is more important in this connection, and the inaccuracy of which will be increased by each boost in taxes. Even the Federal Trade Commission has figured that the chief economy in government-operated utilities is in the lower interest cost. The government has been able to borrow money more cheaply. Actually, governments are now selling on a $2\frac{3}{4}$ per cent basis.

Meanwhile the chief attack on the yardstick is that the government, whether it be of Squeedunk county or the federal government at Washington, does not keep accurate books. The most familiar charge is that in government operation there is never a sufficient allowance for depreciation and obsolescence.

CRITICS insist, therefore, that the comparison of public with private utilities is like the government's maneuvering recently on the corn loans. The Administration was not willing to tell the farmers that it meant to reduce the loans on corn, that it wanted to cut the loans from

—By CARTER FIELD



This noted journalist gives his personal comments and interpretations on current happenings affecting the electrical industry His background and his location at Washington make his thoughts informative and interesting even though all may not agree with him.

45 cents a bushel to something lower. So it calmly changed the size of a bushel! It put in enough more cubic inches to get the actual loan on corn down to the desired figure per ton.

President Roosevelt's forcibly made suggestion about railroad financing, these critics think, should be applied to publicly owned utilities. The President, it will be remembered, sharply criticised past railroad financing, saying a company would borrow money to build a bridge. Years later when the bridge would have to be replaced the company would put out more bonds to finance the expenditure. But meanwhile it had long since included the original cost in its permanent debt, on which interest had to be paid—thus leading to overcapitalization. What ought to be done, the President said, was for railroad companies to provide a sinking fund with every bond issue, and pay the bonds off before the improvements constructed or purchased with the money were worn out. In fact, he went a little further, dwelling on the happy period when the companies would have all their bonded debts paid off, at which time rates could be reduced to the customers!

SO FAR just theory—but behind the President's words is the idea that, through new law and I.C.C. regulation, such a policy might be imposed. And if on the railroads, why not on the utilities? And if on the privately owned utilities, why not on the publicly owned utilities?

Unless some way can be found to present this question to the courts, however, there is little serious probability of it developing. The President does not look on the utilities through the same glasses as those he uses to scan the railroads. Nor have the utilities many friends on Capitol Hill. In fact, it was not until last year, during the death sentence fight on the public utility holding company bill, that most of the national legislators realized that they had utility stockholders among their constituents.

Were it not for this strong slant on the part of the President there is a situation right now which would prune the proposed construction of municipal and other governmentally owned electric plants right down to the bone. The President has become thoroughly alarmed over two phases of one situation—the obvious alarm throughout the country at heavy spending at Washington —and the reluctance of members of Congress to vote more taxes to balance the budget.

This has resulted in two presidential moves—one to curb authorizations for the lending agencies, and the other to curb actual spending. The first had nothing to do with economy. It was money that would not have been spent anyhow. But the second was really meant to get somewhere. Whether it does or does not, it has produced plenty of alarm among the personnel of the spending agencies.

Now it just so happens that most of the allotments for municipal ownership electric plants are in the category marked for slaughter—that is, they have been approved, and all that sort of thing, but no money has actually been spent on them. The reason for this is simple. Nearly all of these allotments have been tied up with injunctions.

So it would seem that the natural course would be to decide not to go ahead with these projects. That would undoubtedly be done were they any other kind of projects. But the President does not want these projects abandoned. It may be that the P.W.A. hints of vigorous action by the sponsors of its various projects will be necessary, but the truth is they have won their fights before they start. The President has all the discretionary power in the world, and has no intention to abandon the setting up of municipal competitors for those corporations which, up until the Liberty League anyway, were his best hated enemies.

INCIDENTALLY, if certain gentry in the Securities and Exchange Commission were sure the President would not hear them, they would admit a mild hope that the law setting up their organization is held unconstitutional when it gets its turn before the high court. Not because of any altruistic desire to give up their jobs, but because they think the law is too drastic. They think a much more workable and satisfactory law could be enacted, and of course each thinks individually that he would be reappointed to the new body.

Which all sounds foolish, but a careful reading of the regulations in comparison with the letter of the law itself will tend to make one more credulous.

Having at last got its appropriation, in the deficiency bill—it had been filibustered to death last session by Huey Long and others—the Federal Power Commission is adding more personnel. It had already assumed regulation of interstate sales.

The glare beating on the Supreme Court and T.V.A. has put R.E.A. almost in total darkness. It is making occasional small loans—22 in all so far—and doing nothing spectacular. Its latest bid for publicity is the idea of putting transmission wires in rural communities underground, but the story, for various reasons, did not make any front pages.

NEWS OF THE WEEK

Compromise on "Little T.V.A." stops most of distribution lines in Nebraska . . . Plans for Edison living memorial announced . . . American & Foreign Power asks exemption from holding company law . . . Utilities attacked in 4 states . . . New science museum opened

Compromise Halts Little T.V.A. Lines

P.W.A. reaches agreement with Nebraska utilities which allows continuation of irrigation development, but enjoins most of transmission lines

Compromise between Nebraska's embattled utilities and the Public Works Administration on development of the "little T.V.A." in the Loup River district brought forth an innovation in such disputes. The final plan, approved by the District of Columbia Supreme Court, provides essentially that the government will proceed with the Tri-County irrigation projects but stop work on most of the power transmission lines until legality of such construction is determined in the courts.

The agreement went a long way toward bearing out P.W.A.'s recent off-the-record declaration that it has no power program, that it simply is in the business of making loans for self-liquidating public works of whatever character desired by the regional authorities.

P.W.A. submits to injunction

The mechanics of the compromise were that, once the agreement was ratified, the P.W.A. submitted to the granting of a temporary injunction to halt its Tri-County power program. The other points were:

The government will continue to use its $10,000,000 allotment for construction of irrigation facilities and power surveys.

Work will continue on Platte Valley and Columbus projects, but building of transmission lines will cease.

The government may finish the North Platte-Grand Island-Columbus transmission system.

Both P.W.A. and the private utilities will seek a "full trial" to test the legality of the generating and transmission aspects of the $56,000,000 project.

What the utilities wanted had been outlined earlier. C. J. Strike, of power company counsel, said:

"If the Loup River or Sutherland district will sell power to us cheaper than we can make it, we will purchase power from them and immediately pass such savings on to our customers. Officers of these two districts have understood our policies from the beginning and have our power costs. The thing we object to is the buildng of federally financed distribution systems controlled in Washington which would destroy our property."

Activity at the scene of the projects, however, has not ceased during the litigation and compromise negotiations in Washington. For example, directors of the Loup River Public Power District announce that Westinghouse Electric was low bidder on the contract for equipment for the Monroe plant. This equipment includes such items as switchboards and controls for the by-pass.

Appropriation of $9,000,000 for the Passamaquoddy power project in Maine, put into the War Department appropriations bill as a rider, was cut out in committee, but members pointed out that this did not block the allocation. Rather, they said, the funds should be provided through the customary procedure of regular appropriations bill.

Edison Memorial Announced

Living memorial and Edison Center to be established in honor of Thomas Alva Edison — National campaign for funds to be inaugurated — Owen D. Young heads committee

Announcement was made at a luncheon meeting of the Edison Pioneers in New York on Tuesday, February 11, of plans to create a memorial to Thomas Alva Edison. This project has been developing for two or three years under the auspices of the Thomas Alva Edison Foundation.

The memorials contemplated thus far consist of:

1. A living memorial to assist youth in education and to stimulate research in science and engineering.

2. To preserve the library and laboratory of Mr. Edison at West Orange and to build a suitable building on this site to contain originals and replicas of his inventions.

3. To make permanent the temporary tower now existing at Menlo Park.

At the luncheon meeting W. S. Barstow, president of the Edison Pioneers, outlined the plans of the foundation. Owen D. Young, who has accepted the chairmanship of the national committee, gave an address in which he pointed out that the work of Mr. Edison deserved these memorials outlined by the foundation to keep alight the torch established by Mr. Edison's work and called upon the fullest co-operation and aid in carrying out the plans of the foundation through a national campaign. George B. Cortelyou, vice-president of the national committee, also spoke and urged the fullest possible response to the work undertaken by the committee. Dr. John H. Finley gave a eulogy on Mr. Edison. stating that his was the wizardry of an inquiring mind and that his contributions helped heal the hurt of Babel. He also urged the fullest co-operation in the purposes of the foundation. Edgar T. Honey, national director of the foundation campaign, stated that all the committees were now organized, with more than 100 prominent business men on the national committee and with chairmen of regional committees established so that the campaign could be extended into all cities and villages of this country. James H. Perkins of the National City Bank of New York has accepted the office of treasurer of the committee and Bruce Barton chairman of the committee on publicity.

Fund drive to start soon

It is expected that the national fund-raising campaign will be initiated in the near future and encouraging responses were had from all sections as regards the possibilities of creating these worthy memorials for Mr. Edison.

More than 200 were in attendance at the luncheon of the Edison Pioneers and received the announcement of the memorial plan with acclaim. Wiliam S. Barstow was re-elected president of the Edison Pioneers for the ensuing year.

Carolinas Urge $17,500,000 Dam

Two large power, flood control and navigation projects—Buzzard's Roost and Santee-Cooper—in the Carolinas may be tied up in the courts, but this is not slowing up the federal public works advocates in the region. Their latest pet project is the $17,500,000 Clark's Hill power and navigation proposal on the Savannah River.

Local legislators have banded together in support of the project, which would employ an estimated 2,000 men for three years, promising to press the campaign on their Congressmen and the Washington administration. South Carolina Senators Nicholson and Williams, conspicuous anti-utility mouthpieces, declare "the people today are paying a tribute to the power companies that is absolutely unwarranted in any free country." This move comes on top of a South Carolina drive for higher taxes on public utilities.

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Electrical Engineers Name Official Slate

The official slate of nominations for officers of the American Institute of Electrical Engineers, made public this week, is headed by A. M. MacCutcheon for the presidency. Mr. MacCutcheon is engineering vice-president of Reliance Electric, Cleveland. For vice-presidents the committee chose the following: A. C. Stevens, General Electric; O. B. Blackwell, Bell Laboratories; C. Francis Harding, Purdue University; L. T. Blaisdell, General Electric, and C. E. Rogers, Pacific Telephone. For treasurer, W. I. Slichter of Columbia University is the nominee, and for directors K. B. McEachron, General Electric; C. A. Powel, Westinghouse Electric, and R. W. Sorensen, California Institute of Technology.

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Oregonians Control Portland Electric

A step in the financial reorganization of Portland Electric Power Company, Portland, by which control of that company is definitely placed in the hands of western operators and ultimate ownership will be vested in the preferred-stock holders has been carried out by Franklin T. Griffith, president. Since 1932 the 175,700-odd shares of comon stock owned by Central Public Service Corporation have been in a voting trust agreement, with Mr. Griffith, J. C. Ainsworth, president of the United States National Bank, Portland, and E. B. MacNaughton, president First National Bank, Portland, as voting trustees. In the recent move the stock and the voting trust certificates are placed in escrow in the First National Bank, Portland, until November 1, 1942, when the voting trust terminates, and ownership of the stock will pass to the Portland Electric Power Company.

It is Mr. Griffith's intention to cancel and retire the stock at that time, leaving outstanding only the various preferred and prior-preference issues now owned by some 13,000 stockholders, 10,000 of whom reside in Oregon. Most of the preferred stock now votes equally with the common stock and when the common stock is retired sole voting rights will remain with these preferred holders.

The Current Drift

Nebraska and Public Ownership

Power companies in Nebraska have compromised with P.W.A. in a fashion to make their fight against the "little T.V.A." almost a friendly battle, but they have not compromised with the voters at home. Public ownership promises to be the burning issue in this year's elections in the state. Veteran Senator George W. Norris probably will head the slate of anti-utility candidates.

Aids of the Senator, who is nominally Republican but very pro-New Deal as far as power is concerned, are busy getting ready questionnaires to send to all candidates. They will take a flat stand for public ownership or face Norris' disfavor—a powerful influence in Nebraska.

Municipal Power Crushed

When Portland, Ore., voted 61,265 to 5,853 against a public ownership project the referendum may not have been properly phrased to get an exact expression of popular opinion, but few in the Western city are in any doubt as to which way the wind blows. The weakness in the question as submitted, both sides agree, was the $50,000 expenditure stipulated for an appraisal. This didn't mean much to any one because appraisals have been made long before this and their results are public record.

An Interesting Precedent

States which feel that their rural electrification programs have not made proper progress can take a lesson from South Carolina, the only state which has organized its own rural electrification authority. This group has the largest appropriation yet authorized in Washington, a total of $1,107,000. It is asking $1,411,905, more which would mean 2,448 miles of line all told and extension of rural service into every county in the state. Yet the local officials have been complaining that the utilities are jumping in with "spite lines" to get the most lucrative territories.

THINGS ARE HUMMING AT GRAND COULEE

Acme

Catwalk-erected, giant traveling cranes in place and concrete being poured in blocks which later will be filled around to build the giant dam that will form the Grand Coulee reservoir on the Columbia River. Fate of this project, along with T.V.A., rests in the hands of the Supreme Court.

Earliest Light Bulbs Seen in Museum

Lamps used in opening Science and Industry display — Four Nobel Prize winners speak in international broadcast of ceremonies in New York

Landmarks along the trail of electric illumination's history flashed, some feebly, some with a powerful blaze, at the formal ceremonies Tuesday evening inaugurating the New York Museum of Science and Industry, Rockefeller Center. An international broadcast, in which three Nobel Prize winners spoke from points as widely separated as London and Pasadena, Calif., marked the occasion.

While the new museum contains exhibits from practically all branches of science, in most cases showing graphically their development, to electric light was given the place of opening the show. In London Sir William Bragg, Nobel Prize winner in physics, touched a match to a candle on Michael Faraday's desk in the Royal Society. The taper's light was picked up by an electric eye, which, in turn, transformed the impulse into energy which illuminated one of the first electric lamps ever made, a bulb which had not been lighted for half a century.

Mercury lamp flashes on

The flash from this old lamp's platinum filament was picked up and transmitted by radio to New York, where it lighted the first electric bulb ever made in the United States, this latter an interesting relic from the Westinghouse collection. Once more the mild illumination of an old lamp was transmitted, this time to a battery, and, with a blaze of light, another Westinghouse product, its newest and never previously publicly shown high-pressure mercury lamp, flashed on.

The ceremonies in New York were presided over by Dr. Frank B. Jewett, head of the museum's board of trustees and president of the Bell Laboratories. Dr. Albert Einstein, a Nobel Prize winner, spoke, but Dr. Irving Langmuir, fourth of the Nobel prize winners on the program, was unable to take part due to the death of his mother. Dr. Robert A. Millikan, another Nobel Prize winner and celebrated physicist, was heard from Pasadena, and Sir William Bragg spoke from London. Mayor F. H. La Guardia also was a speaker.

Exhibits at the museum, which was opened to the public on Wednesday, range through practically all the phases of technical development. Large space is devoted to working displays showing the complex field of electrical devices. In addition, General Electric has an elaborate exhibition of X-ray and its wide range of scientific applications, and the latest developments in sodium lamps are portrayed.

Indicative of the wide variety of fields covered is the listing of a few: Communication, photography, housing, spinning devices in a historical pageant, transportation, food processing and primitive and modern farming implements.

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Power Company Sued In Lightning Death

Georgia Power Company has been made defendant in an unusual suit, H. P. Linton of Woodbury, Ga., asking $50,000 damages, alleging that improper street wiring was responsible for his wife's being fatally injured by lightning.

Note Sale to Employees By A.G. & E. Enjoined

Suits brought by the New York Attorney-General's office to stop allegedly compulsory subscriptions to notes in lieu of a percentage of salary by Associated Gas & Electric employees (ELECTRICAL WORLD, February 1, page 44) resulted in issuance of an injunction by the State Supreme Court on Tuesday. The court also ordered the system not to repurchase below par value notes bought by employees under this plan. The state charges that Associated Gas, through outsiders, made such purchases as soon as the petition for an injunction was filed.

American & Foreign Power Asks S.E.C. for Exemption

Petition complicates status of government's test case against parent company under 1935 law — S.E.C. confers with company representatives on service charge accounting

The status of the government's "hand-picked" case against Electric Bond & Share (seeking to force the latter's compliance with the Public Utility Act of 1935 and, into the bargain, test the act's constitutionality) was further complicated this week when Bond & Share's subsidiary, American & Foreign Power, asked exemption from the workings of the law and liability thereunder.

The statute implies no responsibility for companies whose business is entirely outside the United States — Foreign Power sets forth that its operations are wholly foreign—but the S.E.C. not long ago ruled that such set-ups are not necessarily exempt if, in the public interest, they should in fact lend themselves to the regulation contemplated under the act. The ruling set forth, too, that the commission should decide the right to exemption if the company is organized under the laws of any state and Foreign Power holds a Maine charter. Thereby hangs the latest question of jurisdiction —the newest question of S.E.C. power.

Service charge conference

Another point of paramount importance, if the law is held constitutional, came up recently when the S.E.C. called together and conferred with utility experts on service charge accounting and its implications in the holding company picture. The meeting was described by Washington officials as purely informal, but the coterie of names made it more than routine, viz., for the government, William M. Hammond, an accounting expert for the S.E.C., and Carmen Blough, chief accounting officer for the commission, and for the utilities, William B. Winans, Cities Service; Clarence E. Packman, Middle West Corporation (registered); Joseph M. Burchill, American Gas & Electric Company; Paul D. Preger, North American Company; G. H. Bourne, Commonwealth & Southern; Franklin P. Jackson, Jr., New England Power Association (registered); Francis J. Brett, Niagara Hudson Power; W. C. Lang, Electric Bond & Share and Ebasco Services, and Jason C. Leighton, Engineers Public Service. Moreover, the S.E.C. intends to call in representatives of the American Institute of Accountants on the same subject later.

Few "insiders" report

As though the Public Utility Act were not under fire from enough angles, another challenge was clearly implied when the S.E.C. made public the first list of data on officers' and directors' holdings of securities. Of course, it was to be expected that only officials of registered companies would report, but the initial list required barely a typewritten page to reproduce, the names and numbers were of little public interest.

Under Title II of the law (the F.P.C.'s section) there now is on file the first application for emergency connection of systems. It is the application of Kansas Gas & Electric (Bond & Share affiliate) to connect its lines with Oklahoma Gas & Electric (Standard Gas property) at the Kansas-Oklahoma border and with Empire District Electric (Cities Service subsidiary) at the Empire plant on the Neosha River, neither interconnection to be called upon excepting in case of emergency.

In Washington there is no admission

that the Public Utility Act may be thrown out. Witness the funds approved for its administration in the supplemental appropriations bill (substitute for the measure which the late Huey P. Long of Louisiana filibustered into the discard at the end of the last session of Congress) that gives the S.E.C. $765,000 and the Federal Power Commission $600,000 to carry out the law's terms.

Despite all litigation, there still is some acknowledgment of the S.E.C.: Montana-Dakota Utilities Company, a registered holding company, has applied for authority to carry out an integrating merger. The company would acquire Montana Cities Gas and Montana-Dakota Power, two subsidiaries, authority for which was recently asked. Now permission to solicit proxies is the point on which commission approval is solicited.

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Ex-Sergeant Settles Havana Light Dispute

Cuba's amazing young military man, Col. Fulgencio Batista, who was an inconspicuous sergeant in the waning days of the Machado régime but thereafter was catapulted into the post of chief of staff, now has stepped into the power situation in Havana. The result: Anti-utility Mayor Guillermo Belt has resigned and an agreement with American & Foreign Power's Compania Cubana de Electricidad has been reached.

The company had been turning off street lights piecemeal, threatening darkness if the $250,000 overdue city bill was not paid. Dr. Belt had refused to negotiate until full service was restored.

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Electric Lights Come to Mohammed's Tomb

Mohammed ordered the mountain to come to him, or so the story goes, but it is doubtful if the founder of Islam's faith ever contemplated commanding electricity to come to his tomb. Yet that is just what is happening. The Nizam of Hyderabad has appropriated 50,000 rupees from his Silver Jubilee fund for electric lights in the Prophet's tomb at Medina, second only to Mecca as a Moslem shrine.

The ancient mosque, near the hut where Mohammed died, was built shortly after his death in 632, enlarged under the Caliph in 711 to include his burial place, and twice since has been restored after fires.

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City's Lighting Outlay

One of the sizable lighting equipment budgets of 1936 is that of the New York City Commission of Water, Gas and Electricity—about $1,250,000. Contracts already have been let for $400,000 of new lighting installations.

Utilities Attacked in Four States

New York committee ends its hearings with charge of stock watering — Bay state may facilitate municipal plants — Mr. Bangs on rampage again

Attacks on public utilities have been heard in four states in the last few days, one of the most vigorous criticisms marking the last sessions of New York state's legislative investigating committee, which is due to submit its report and recommendations today. This group, headed by John E. Mack as counsel, wound up its hearings by charging stock watering to pad the rate base and warning public utilities to clean house or face public ownership.

While such stinging allegations as claims that the state's utilities have watered stock to the extent of $225,000,000 attracted wide attention, the report will probably be subject to a bitter attack in the Legislature on the grounds that inquiring has not answered the questions for which it was given $500,000. The investigation was launched to probe the connection of legislators with the utilities (Senator Warren Thayer's reputed gifts from Associated Gas precipitated the inquiry), but it found no such ties and quickly shifted to delving into utility operations. This alleged whitewash is reported to be one of the reasons Gov. Herbert H. Lehman has opposed extending the committee's life.

Pennsylvania seeks books

In the meantime an Associated Gas stock deal was under fire in Pennsylvania, where the state Public Service Commission demanded data on Metropolitan Edison's purchase of 12,240 Utilities Mutual stock for $244,800. Efforts to hide the transaction were charged, out-of-the-state books demanded.

Massachusetts' legislative gladiators also are jousting with the rate bogey. The Senate quickly approved the special committee report attacking many utility practices (ELECTRICAL WORLD, February 8, page 6) and a dozen bills were introduced in the Legislature with a view to removing restrictions on municipal plants. The program aims at forcing rate reductions by public ownership threats.

The Public Service Commission in Indiana again has on its hands the militant Clare W. H. Bangs, Mayor of Huntington and the man who served more than 100 days in jail last year for contempt of court in his fight to extend his municipal system. Coming to Indianapolis with a small army of Huntington citizens, Bangs urged that the city be allowed to extend lines within the borders and into surrounding rural territory. Northern Indiana Power Company was accused of poor service.

SODIUM LAMPS FOR NEW BRIDGE

The Gen. Clarence R. Edwards Memorial Bridge, a 1,500-ft. six-lane span over the Saugus River between Revere and Lynn, Mass., eliminates glare and shadows with 24 sodium lamps of 10,000 lumens at 100-ft. opposite spacing. On the Revere side ten 195-watt series type luminaires are installed; those on the Lynn side are multiple type lamps of 250 watts each.

South Carolina Requests $1,411,905 from R.E.A.

Loan sought in addition to $1,107,000 already received — State plans 2,448 miles of rural line — Grant of $100,000 is approved for private company's project in Minnesota

South Carolina not only stands in first place as to Rural Electrification Administration loans already approved—$1,107,000 has been granted—but has asked an additional grant of $1,411,905, it was learned this week. Grants attained point to the advantages of the state rural electrification administration plan of development, in which field South Carolina so far is the one and only.

The additional loan would allow, under the plan, for construction of 1,418 miles of rural lines in addition to the 1,030 now about half staked out. The total of 2,448 miles of line would serve some 9,597 farm customers with every single county in the state included in the program, according to A. J. Beattie, state comptroller general and secretary of the authority. There is only one weakness in this ambitious program—while contracts have been let for $132,000 of work, none has as yet actually got under way.

R.E.A. announces approval of a loan of $100,000 to the Farm Electric Service Company of Aitkin, Minn., for construction of 100 miles of rural line to serve about 300 new customers, most of them dairy farmers. Farm Electric Service, despite the fact that its name sounds like a co-operative, is a private concern, subsidiary of Rural Utilities Company. The parent company, in turn, buys its energy from Minnesota Power & Light on a sliding rate scale. The cost to new customers on the contemplated line is $6.45 per 100 kw.-hr. a month.

Other items on rural electrification follow:

ALABAMA—Plans of Alabama Power Company call for expenditure of $1,200,000 on rural lines this year, part of a budget of $9,700,000 for conducting business in the state in 1936.

ARKANSAS — Inauguration of 24-hour service through a new 14-mile line serving some 65 homes in Lonsdale, Ten-Mile and Point View, Ark., is celebrated by local citizens and state officials, including Gov. J. Marion Futrell. The line was put through by Arkansas Power & Light, the company being congratulated in a telegram from Morris L. Cooke, R.E.A. administrator, for its "fine spirit."

FLORIDA—Jacksonville's extension of lines contemplates rural electrification to the town of Mandarin in its next move, according to Ernest Anders, city utilities commissioner. This would follow completion of the line to Oceanway. The entire program includes connection of eleven towns to the municipal system at a cost of $70,000 for materials.

MINNESOTA—Steele County Electric Association is organized by farmers headed by Alex Chambers, Havana, as president, and Edward Springer, Merton, secretary-treasurer.

NEW YORK—About 300 farm customers sign up in Wayne Farm Bureau drive for 90 miles of line. Rural extensions totaling nearly 100 miles are planned by Peoples Gas & Electric in Oswego County this year to serve about 400 new customers.

VIRGINIA—Plans for rural electrification in King and Queen County are discussed at large meeting of citizens. Committees to report later, J. D. Hutchinson elected chairman and instructed to canvass territory.

WEST VIRGINIA — Barbour County residents plan to seek $100,000 R.E.A. loan for 110 miles of line. Raymond Murphy is chairman of the committee.

NEBRASKA — State Railway Commission authorizes Nebraska Power Company to erect rural lines in the vicinity of Orum and Fontenell, Neb. Reduction of the scope of Southern Nebraska Power District to include only Phelps, Kearney and Adams counties, instead of twelve counties, is proposed, with a loan of $400,000 for 400 miles of line contemplated. Legal action is planned to decide the boundaries of Lancaster County Rural Public Power District and Eastern Nebraska District in a friendly suit to facilitate applications for R.E.A. loans. The Eastern Nebraska District wants $600,000 and the Lancaster County $400,000 at present.

COMING MEETINGS

Minnesota Electrical Association — Annual convention, St. Cloud, Minn., February 21-22. William A. Ritte, St. Peter, Minn., secretary-treasurer.

Vermont Electrical Association—Winter meeting, Sherwood Hotel, Burlington, Vt., February 27. C. M. Jennings, secretary.

Edison Electric Institute—Third annual sales conference and sales committee meetings, Edgewater Beach Hotel, Chicago, Ill., March 23-27. Bernard F. Weadock, managing director, 420 Lexington Avenue, New York, N. Y.

Florida Engineering Society — Annual meeting, Daytona Beach, Fla., April 2-4. W. W. Fineren, secretary, University of Florida, Gainesville.

Midwest Power Engineering Conference—Chicago, Ill., April 20-24. G. E. Pfisterer, secretary, 308 West Washington St., Chicago, Ill.

Association of Iron and Steel Electrical Engineers—Spring engineering conference, Youngstown, Ohio, April 22-23. Brent Wiley, managing director, Empire Building, Pittsburgh, Pa.

Electrochemical Society — Spring meeting, Cincinnati, Ohio, April 23-25. Colin G. Fink, secretary, Columbia University, New York, N. Y.

Missouri Association of Public Utilities—Annual meeting, St. Louis, Mo., April 29-May 1. Jesse Blythe, assistant secretary, Merchants Bank Bldg., 101 West High St., Jefferson City, Mo.

American Institute of Electrical Engineers—North Eastern District meeting, New Haven, Conn., May 6-8; summer convention, Huntington Hotel, Pasadena, Calif., June 22-26. H. H. Henline, national secretary, 33 West 39th Street, New York.

National Electrical Manufacturers Association—Spring meeting, The Homestead, Hot Springs, Va., May 25-28. W. J. Donald, managing director, 155 East 44th Street, New York.

Illinois Chapter, I.A.E.I. Holds Meeting in Chicago

Despite the bitterest cold in years, coupled with transportation difficulties, about 60 members attended the recent meeting of the Illinois chapter, I.A.E.I. Among the program features were Alfred Herz's talk, "Grounds and Groundings"; an address on safety and individual responsibilities by W. Dean Keefer, National Safety Council; I.A.E.I.'s part in fire prevention, told by Orville F. Cullerton, and Commonwealth Edison's experience with thefts of electrical energy during the depression, outlined by A. R. Leighton.

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A.G.&E. Sales Engineers Meet at Nela Park

Some 60 power sales engineers of the Associated Gas & Electric System, meeting recently at Nela Park, Cleveland, received instruction in lighting, electrical furnace applications, air conditioning and Diesel competition. Talks on market survey and analysis were on the program, along with inspection trips to many of the industrial plants in the area, stressing electric furnaces, baking and industrial lighting.

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Best Lighted Alley Claimed by Chicago

Chicago has what is touted as the best lighted alley in America between South Dearborn and Clark streets, north of the Edison and Marquette buildings. Two G.E. sodium lamps and one mercury-incandescent luminaire have been installed by Commonwealth Edison, partly for demonstration purposes, but partially for night work and for protection against prowlers as well.

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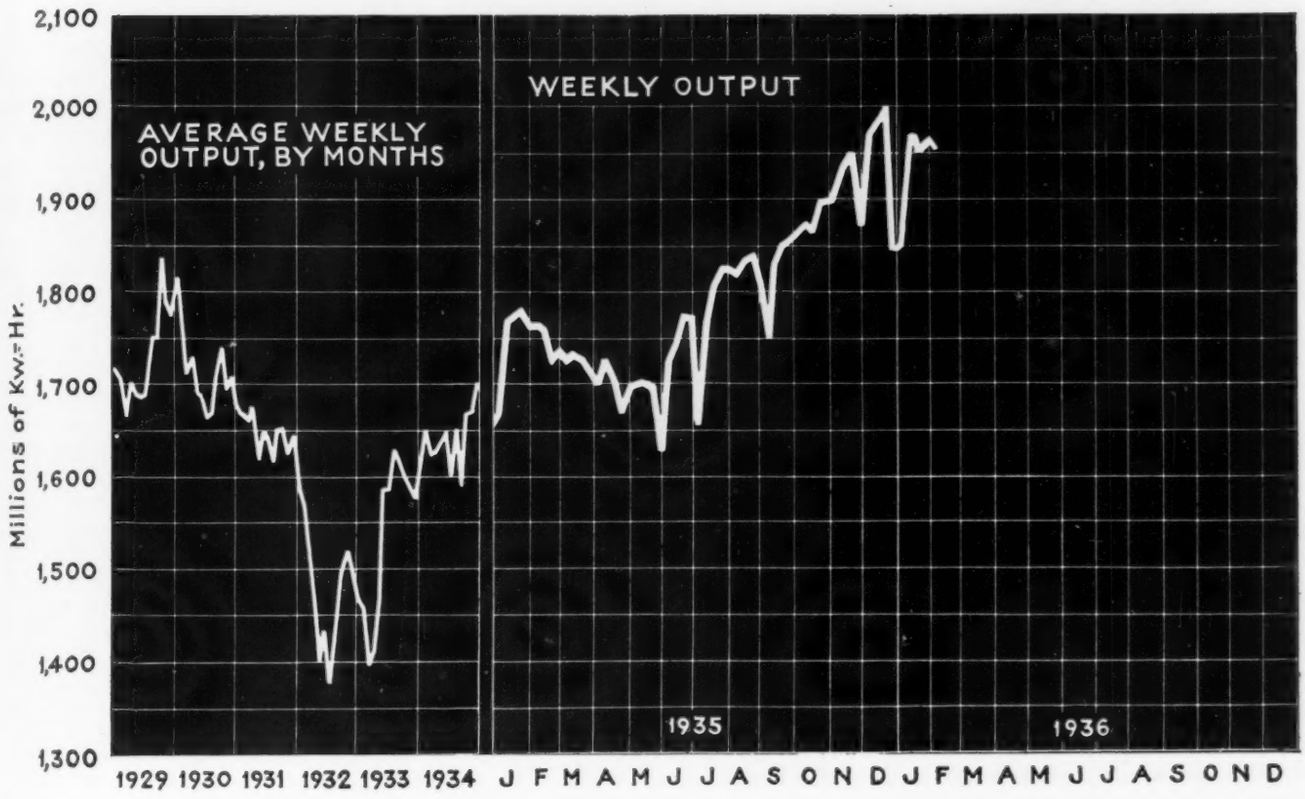
Commercial Meeting's Program Expanded

Growing importance of the work being done by the commercial departments of the public utilities is recognized by the Northwest Electric Light and Power Association this year, the eleventh annual conference being scheduled for two and one-half instead of the usual two days—March 5 to 7, inclusive, in Spokane. W. C. Mainwaring, British Columbia Electric Railway Company, who is chairman of the commercial section, is in charge of arrangements.

Output Lead Over 1930 Increasing



The energy output of central electric light and power stations continues to surpass previous records. For the week ended February 8 it amounted to 1,952,476,000 kw.-hr., according to the Edison Electric Institute. This was a gain of 10.7 per cent over the like week of 1935 and 9.5 per cent over 1930. The margin over the record winter of 1929-1930 is gradually widening. With the exception of two weeks at the turn of the year it is now larger than ever before. The excess over last winter is being maintained. The recession from the December peak was smaller than in any of the past six years except 1934 and 1935.

The advance over 1935 was general. In the Middle Atlantic and Central industrial regions and in the South it approximated the national average. On the Pacific Coast it was somewhat larger and in New England smaller, but the most striking gains continue to be reported from the Rocky Mountain states, where large percentages have persisted for more than a year.

Per Cent Change from Previous Year

Region	Week ended Feb. 8	Feb. 1	Jan. 25
New England	+ 7.4	+ 7.4	+ 5.7
Middle Atlantic	+10.1	+ 8.4	+ 7.5
Central Industrial	+10.1	+10.5	+ 8.3
West Central	+12.8	+11.9	+11.7
Southern States	+11.9	+12.3	+12.3
Rocky Mountain	+26.7	+28.0	+22.4
Pacific Coast	+12.6	+16.1	+12.2
United States	+10.7	+11.4	+ 9.8

Weekly Output, Millions of Kw.-Hr.

1936	1935	1934
Feb. 8...1,952	Feb. 9...1,764	Feb. 10...1,652
Feb. 1...1,963	Feb. 2...1,763	Feb. 3...1,636
Jan. 25...1,956	Jan. 26...1,782	Jan. 27...1,611
Jan. 18...1,950	Jan. 19...1,778	Jan. 20...1,625
Jan. 11...1,971	Jan. 12...1,773	Jan. 13...1,646
Jan. 4...1,855	Jan. 5...1,669	Jan. 6...1,564

Ontario Weighs New Contracts

Final arrangements for new contracts between Ontario Hydro and Gatineau Power are expected in the near future with the company giving the commission its choice of two new agreements. An interesting feature of negotiations has been the appearance of A. R. Graustein before the commission despite his resignation from International Paper & Power, Gatineau's parent company, about ten days ago.

Cancellation of the old contracts continues a bitter controversial point, the latest blast coming from Beauharnois Power, the management of which recommends formation of bondholders' protective committees. Officials say that there is no chance of earning interest under present circumstances, much less depreciation and amortization.

The Ontario Municipal Electric Association has patched up its recently dubious relations with Hydro, declaring in its Toronto convention that it harbors no hard feelings, is not opposed to the commission and expects co-operation from the provincial authorities.

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England to Discuss Rural Electrification

Extension of rural electrification in England soon will be the subject of a conference under the chairmanship of Sir Merrick Burrell, president of the Royal Agricultural Society, at Rothamsted Experimental Station. Agricultural uses for electricity, farm wiring and employment of electric motors will be among the topics discussed.

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Farmers Oppose Dam on Staunton River

Opposition to the proposed 165-ft. power dam of the Smith Mountain Power Company on the Staunton River in Virginia was voiced before the state Corporation Commission last week by land owners along the stream. Farmers objected not only to the 9,800-acre lake but to damming the stream, which, they said, would eliminate the spread of river bottom silt to the detriment of crops.

Utility Stocks Inactive

Electric light and power stocks moved within a narrow range this week. The "Electrical World" index remained unchanged at 36.5.

New Utility Issues Ready for Market

Although public utility financing in fair volume is certain in the fairly near future, most of the imminent issues right now are in the just-before-being-approved stage. This is true of New York Edison's $55,000,000 of first lien 3½s, approved by state authorities but now awaiting S.E.C. authorization. Another big step in the Consolidated Gas refunding program is the plan, still some little time off, for $70,000,000 of debentures.

Another big issue which will be ready for the market this spring is for Consumers Power Company, probably $50,000,000. This issue, it is reported, would refund a like amount of 4½s outstanding.

The pending issue of $17,500,000 of 4s of the New York Electric & Gas Corporation is due anyday.

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Municipal Plant Sold

Purchase of the Crystal Springs, Miss., municipal water and electric system is announced by the Mississippi Power & Light Company. Almost simultaneously it was learned that Bernstein Garment Manufacturing Company, New York, is to locate a plant in the town.

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$553,800 for Homes

Home loans aggregating $553,800 were made to 163 Commonwealth Edison Company employees through its savings and loan association in 1935, compared with $320,000 for 99 employees in 1934, the company announces. Assistance was allowed for purchase or construction of homes.

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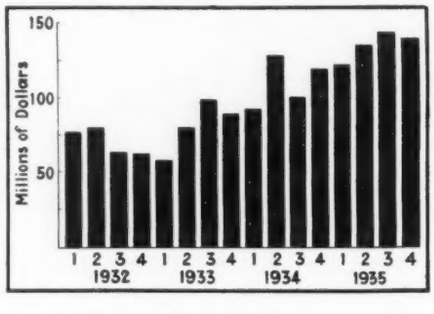
Electrical Orders Up 23 per Cent

New orders booked during 1935, as reported to the Bureau of the Census by 78 manufacturers of electrical goods, were 23 per cent higher in value than in 1934, the total being $538,883,328 against $439,067,287 in the earlier year and $325,066,108 in 1933.

Comparative figures by quarters, in thousands of dollars, were as follows:

Year	First	Second	Third	Fourth
1935....	121,814	134,925	143,132	139,012
1934....	92,302	128,034	100,334	118,397
1933....	57,897	79,856	98,768	88,544

Orders in the fourth quarter were 18 per cent above the 1934 figure and 57 per cent above 1933. The year's total was the largest since 1931, when it amounted to $578,723,668, and it was virtually double the depression minimum to which it dropped in 1932.



Orders for electrical goods reported by 78 manufacturers

Hetch-Hetchy Plan Received by Ickes

Officials of the city of San Francisco have proposed to Secretary of the Interior Harold L. Ickes a plan for the disposal of hydro-electric power from plants on the city's Hetch-Hetchy water supply system. Sale of this power to the Pacific Gas & Electric Company under the "temporary" contract which has been in effect for approximately ten years was recently ruled by the Secretary to be a violation of the Raker Act, which granted the city authority to utilize government land in the Hetch-Hetchy development.

In brief, the plan proposed is as follows: Operation of the present Hetch-Hetchy power plants by the city as at present; no change in the status of the 98-mile transmission line; sale of all energy to P.G.&E. at Newark, as at present, at a 75 per cent load factor; repurchase of the same amount of energy, but at 43 per cent load factor at P.G.&E. substations in San Francisco. The sums involved in the sale and purchase are identical. The city contends that it would thus regain ownership of all firm power. The city would purchase part of P.G.&E.'s distribution system in San Francisco.

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Power System Grows

Addition during the fall months of more than 100 miles of line to serve 420 customers is reported by the New Brunswick Electric Power Commission. The commission also plans to double the capacity of its Grand Lake power plant.

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More Power Customers

City Gas & Electric Corporation, operating in several Quebec cities, increased the number of connected customers to 2,757 in 1935 from 2,346 at the end of 1934.

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Thirty-five Years of Rate History

Thirty-five years in the history of electric rates in Bergen County, New Jersey, have been unearthed by the Public Service Corporation of New Jersey. An advertisement appearing in local newspapers in January, 1900, has been brought to light and the rates it quotes, compared with present charges, are reproduced in the accompanying table.

Kw.-Hr.	1936	1900
25	$1.92	$4.25
50	3.00	8.50
100	4.50	16.00
200	7.50	30.00
250	8.75	35.00

MANUFACTURING AND MARKETS

N.E.M.A. Outlines System of Co-ordinating Bureaus

Swartzbaugh tells members of progress made since meeting last spring in developing and broadening program for improving markets of electrical manufacturers

The lines along which the National Electrical Manufacturers Association is moving, its most recent accomplishments and its present aims were clearly outlined before the organization's midwinter meeting last week by C. E. Swartzbaugh, chairman of the business development committee, at the general meeting Thursday afternoon. Mr. Swartzbaugh's talk reviewed activities since the spring meeting in May, 1935.

Among the high spots in the speaker's report was his outline of the bureau organization for business development within the N.E.M.A. setup. This was designed to meet the need for some new type of organization to facilitate co-ordination of various activities for maximum results, Mr. Swartzbaugh stated, and resulted in formation of six bureaus, each of which will deal with a certain market, as follows: Residential, commercial, industrial, utility, farm and governmental.

The manner in which the program is co-ordinated is shown in the breakdown of the residential market into four major divisions—kitchen, living quarters, house grounds and basement. Similarly, in the industrial bureau there are two divisions—a program for those who improve working conditions and a second for those who improve production methods and output. These, in turn, will be broken down into individual programs which would be supported by those companies whose products fit the picture. Certain general programs, such as adequate wiring and Better Light-Better Sight, which are of interest to practically all manufacturers, would be tied in with all the bureaus and the individual programs, while all of N.E.M.A.'s present services will be enlisted in this job of increasing business.

In a rapid-fire survey Mr. Swartzbaugh summarized the work which had been done in the fields outlined at last year's spring meeting. In the matter of inter-industry relation, he said a steering committee is drafting policies for the business development committee. To keep architects and builders informed, he pointed out, N.E.M.A. has joined the Producers' Council. To improve co-operation with electrical leagues the International Association of Electrical Leagues was launched at a meeting in Washington last month.

The program of co-operation with electrical maintenance engineers has resulted in organization of a number of maintenance engineers' groups under local electrical leagues, Mr. Swartzbaugh said, the leagues welcoming N.E.M.A.'s assistance. He pointed out that previous efforts to advance adequate wiring have had merit, but, in an effort to get more general co-operation, N.E.M.A. has appointed a preliminary planning committee to draw up a program which may ultimately embrace all branches of the industry. Section and group activities have been broadened, some of the subdivisions which already have embarked upon market promotion programs being the electrical welding section, the domestic electric appliance section, the street lighting section, the electrical industrial furnace section, the conduit fittings section and the outlet and switchbox section.

In kitchen modernization a national bureau has been organized, jointly sponsored by N.E.M.A. and the Edison Electric Institute, the funds being provided by N.E.M.A. members, with some 23 sections of the association already enlisted. In the field of electrical housewares, manufacturers of domestic appliances for the third year are undertaking a market development program.

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Tests of Resistor Type Rocking Furnace Made

Tests are now being made by the Detroit Electric Furnace Company of a resistor type rocking furnace which, the company states, is expected to allow unusual temperature control. It is explained that the rocking mechanism is similar to that now being used, while a resistor element has been adapted by mounting a graphite resistor on the central axis of the furnace and connecting it to a special transformer.

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Air Conditioning Gains

Contracts for seventeen new air-conditioning systems of 585 hp. were awarded in Chicago during January, Commonwealth Edison Company reports. This is an increase of 30 per cent over the first month last year.

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Telescope Contract Let

The observatory council of California Institute of Technology, Pasadena, has awarded a contract to Westinghouse Electric & Manufacturing for construction of the mechanical parts of the 200-in. telescope for Palomar Mountain.

PRESIDENT AND EX-PRESIDENT CHAT

Frank C. Jones, Okonite president, N.E.M.A.'s present chief, and J. S. Tritle of Westinghouse, past-president of the association, seem to be enjoying the midwinter meeting as they pause between sessions at the Waldorf-Astoria.

Air Conditioning Object Lessons

As of December 31, 1935, there were 934 air-conditioning installations in Chicago adding up to 48,942 hp. of connected load. Considering that nearly 700 of the present total number of installations were made in 1933, '34 and '35, it was fitting that members of the Great Lakes Power Club at their recent meeting in Chicago should listen respectfully while William P. Rock of the Commonwealth Edison Company recounted "Three Years' Observation and Experience in Air Conditioning Promotion." One of the most powerful forces working for growth of the air-conditioning load in the commercial field, he said, is competition among users, present and potential. When one drug store lures patrons to its soda fountain by cooling them externally as well as internally, the owner of the drug store across the street begins to think.

Although personal comfort is the great popular appeal, promoters of the art should not lose sight of the fact that atmosphere control for industrial processes has not by any means reached full application, H. A. Stade, Kroeschell Engineering Company, pointed out.

•

Ends Foreign Investment

Sale of its interest in the Carrier Engineering Company, Ltd., of England is announced by the Carrier Corporation, Newark, N. J. The proceeds, approximately $500,000, were added to working capital.

•

T.V.A. Awards Contract

Contracts totaling $69,600 for 2,300-volt metal-clad switchgear and 161-kv. switches for the Wheeler Dam development have been awarded to Delta-Star Electric Company by T.V.A., according to H. W. Young, president.

•

Industrial Switchboard

Electric Panel Manufacturing, Ltd., of Vancouver, has just completed the erection of one of the largest switchboards ever made in British Columbia, 9x19 ft., in the Western Bridge Company's Vancouver plant.

•

Ohio Brass Earnings Dip

Net earnings of Ohio Brass Company and subsidiaries declined to $348,992 after taxes and all charges for 1935, against $500,271 in 1934.

Kelvinator Receives Two Federal Contracts

Contracts calling for the installation of 1,278 Kelvinator electric refrigerators have been awarded by the Public Works Administration for two federal housing projects in Atlanta, Ga., it was announced recently. There are to be 603 units in the Techwood project and 675 in the University development.

New York Metal Prices

	Feb. 5, 1936 Cents per Pound	Feb. 11, 1936 Cents per Pound
Copper electrolytic	9.25*	9.25*
Lead, Am. S. & R. price	4.50	4.50
Antimony	12.875	12.875
Nickel ingot	35.00	35.00
Zinc spot	5.225	5.225
Tin Straits	48.00	47.875
Aluminum, 99 per cent	19—21	19—21

*Delivered Connecticut Valley.

Field Reports on Business

Reports to ELECTRICAL WORLD *from observers in the field indicate that, even at mid-February, there has been little if anything which looks like an early spring business upturn. Most favorable factors: Cold weather aids coal industry, steel trade expands without help from motors. Drawbacks to recovery: Inflation demands, continued delay in court decisions vital to the public utility companies.*

NEW ENGLAND

An uneven trend in sales of electrical equipment is noted in this district. Inquiries continue to come in but buying of heavy electrical machinery lags and orders for power equipment are confined to small motors. One manufacturer records active interest on the part of textile mills for installation of individual drives and reports a recent sale of eighteen motors with ratings of from 5 to 10 hp. for a Massachusetts mill; other orders are expected as soon as the engineering details are worked out.

Industrial heating equipment is moving well and sales for the past month show an encouraging trend; a prominent manufacturer of industrial electric furnaces with headquarters in Rhode Island reports interest in units ranging between 20 and 50 kw. and notes a strong trend in the adoption of this type for general purpose use in this district. Spot welders are in demand and accessories for this type are selling well with considerable activity in the shipyards. In the domestic appliance field, ranges and refrigerators continue to lead in interest; during the past week one large group of apartments placed an order for 240 ranges and a like number of electric refrigerators. Business in this line, according to a well-known distributor, shows an advance over last year for the first month.

A Connecticut ceramics manufacturer reports improving business in street lighting fixtures and insulators.

PACIFIC COAST

Sales reports indicate fair first of the month orders for both quantity and variety with pole line construction material and cable the leading lines. Such contractors' staples as porcelain and wiring devices are showing the best proportionate increase due to rather widely scattered residential building. Appliance business continues excellent, partly from the stimulation of conventions, shows and campaigns, but mainly from replacement of holiday stocks and a consumer demand which is rather surprising for this period of the year.

Bare and weatherproof copper wire predominates in the Utah sector, insulators and cable in southern California, and hardware, poles and crossarms in central California. Meters, transformers and other electrical machinery temporarily are in abeyance. San Francisco is now benefiting directly, several months before the actual bridge demand, from widening and better lighting of approach thoroughfares to the Gate and Bay bridges. This necessitates the shifting of pole lines; many poles and arms and all the hardware are being replaced.

One recent order covered three carloads of 1½-in. rigid iron conduit and a thousand ground rods to cover underground construction on the projected boulevards. Bids soon will be requested on a $6,000,000 terminal building and track system for the Bay Bridge and, inasmuch as this total includes the laying of bridge tracks for interurban lines, the electrical portion is expected to be high. The problem of conflicting systems and common tracks will be met by a 600-volt third rail for the key route and a 1,200-volt overhead catenary for the Southern Pacific.

NEW YORK

The ability of the steel industry to advance its output to the best levels in six weeks or more (despite the continued contraction of automobile production) and the counter-seasonal record in generation of electrical energy stand out as the two inspiring features of an otherwise disappointing business situation. In most lines the expansion anticipated early in the new year certainly has not developed, most of the indexes have sagged rather than risen.

More and more the inflation threats from the soft-money bloc in Washington and the overhanging court decisions on the New Deal power program loom as barriers. The prospect of inflation is deterring industrial expansion; the court verdicts are postponing the power companies' programs of increasing generating capacity. A fair movement of smaller electrical equipment and appliance volume about as expected are hopeful features.

CHICAGO

Trade in this district was spotty again last week. Retail volume climbed slightly as temperatures moderated but activity was still below normal. Car loadings increased, however, due largely to the exceptional demand for coal.

One manufacturer of electric motors reports the largest order in five years for replacements in an industrial modernization project. Wire and cable orders are maintaining the increases shown over last year. Electric appliance sales declined along with the slackening of retail trade. January brought seventeen new installations of air-conditioning systems in Chicago with a 585 hp. capacity producing 427 tons of refrigeration. This is an increase of 30 per cent over the corresponding period last year.

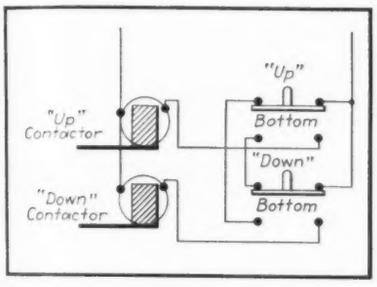
Purchasing by utilities for other than necessary items is retarded, apparently awaiting the T.V.A. decision.

FIELD OPERATING PRACTICES

New ideas and practices in the operation of well-designed, constructed and maintained plants and systems

To Prevent Burning Out Contactor Coils

Burned out contactor coils are a very considerable item of electrical maintenance in any large machine production plant. For setting tools or examining work push-button motor controls are very handy indeed and with a little practice the machine operator becomes very expert at inching the drive. On some machines inching facilities are specially provided in addition to the regular drive. Typical of such machines are forming presses with their auxiliary motors for raising and lowering the rams very slowly for die fitting. The die maker wants to stop the ram just exactly—there! The forward and reversing contactors in the motor control are mechanically interlocked so that one must be open when the other is closed. The man at the press, inching the ram up or down to exactly where he wants it, has one finger on the "Up" button and another on the "Down." He presses first one and then the other, which is all right and no harm is done. But once in a while, in his absorption, he presses both at once and this is what burns out contactor coils, because both the "Up" and "Down" contactor coils are energized and neither one can operate because of the mechanical interlock between them.



Push-button arrangement prevents burned-out contactor coils

But this sort of thing does not happen any more in the press shops at the Chevrolet plant at Flint, Mich. All of the "Up" and "Down" inching buttons on the forming presses have been changed from single to double contact. When the "Up" button is pressed the "Down" circuit is opened, and vice versa. Thus, it is impossible for both contactor coils to be energized by pressing on both buttons at once. The effect is the opposite; that is, both contactor coils are de-energized when the two buttons are pressed simultaneously.

•

Aerial Surveys Aid Mapping Rural Lines

By ROY E. WENK
Everett, Wash.

Sufficient information is often lacking regarding existing or possible line routes in sparsely settled areas. In one district of a Northwestern utility access to an aerial survey proved a valuable aid in mapping. A plane had been flown at a uniform height above the earth taking a series of photographs scaling the area accurately 1,000 ft. to the inch. The whole terrain, roads, farms, sections, water courses and every feature, was faithfully portrayed. With a magnifying glass, even the poles could be seen.

These maps save money and time when considering the feasibility of making new service connections. If a prospective customer lives on the line, facilities required to provide service may be determined without the necessity of making a trip out on the ground. If beyond the existing lines, an extension estimate may be readily prepared.

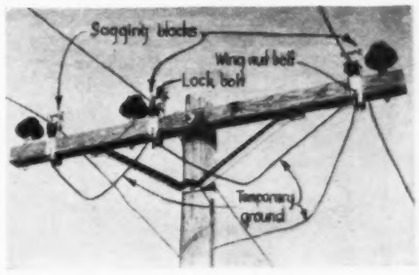
In the case of outages, trouble is localized with greater facility. The problem of dispatching repair crews is much simplified. Much unnecessary patrolling can be eliminated, the crews going directly to the section in trouble. In a recent severe windstorm, where the damage was extensive, maps proved an invaluable aid to the restoration of service.

With good maps bearing all data pertaining to the line inventory and appraisal work is greatly facilitated.

Sagging Block Aids Stringing

By CARL R. WENZ
Assistant Superintendent of Construction, Oklahoma Gas & Electric Company

Due to the difficulties encountered in stringing wire over wooden crossarms, a sagging block was developed for flat-line construction, which eliminates all of the objectionable factors encountered with older methods. This block consists of a cast-iron sheave with bronze self-lubricating bearings mounted in a steel frame which may be attached to crossarms of various dimensions. A wing-nut bolt at the top of the block frame prevents the conductor escaping from the guides when pulled in below or over existing lines in operation. The block also provides a stationary position for attachment of grounding equipment, which has been a long-recognized necessity for safety of workmen.



For faster stringing

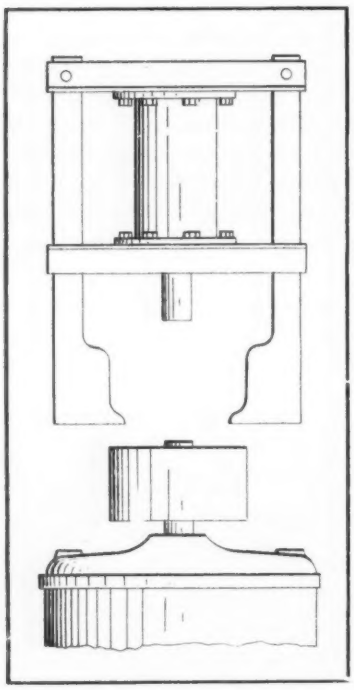
Through the use of these blocks the adjacent wire sags instantly equalize, even on comparatively short spans. From 2½ to 3 miles of conductor may be sagged at one time, thus expediting wire stringing operations.

•

Motor Pulley Puller a Smooth Performer

For the smooth, even, exertion of great strength it is hard to find anything better than a hydraulic jack. This is why the motor pulley puller built and in use in the motor shop of

Chevrolet plant No. 7 at Flint, Mich., is of the form illustrated in the accompanying sketch. The puller, which is a hand pump, hydraulic jack lying horizontally, is mounted in an angle-iron frame supported by four legs about twenty inches from the floor. The motor from which the pulley is to be removed is hoisted by a crane to the level of the jack. Then the puller arms are fastened to the pulley sides and locked with a chain and the jack



Pulley pulling made a simple matter

piston shaft is butted against the end of the motor shaft. Then the operator works the jack handle and pretty soon the pulley marches slowly and with dignity off the motor shaft. After struggling with screw type pullers for many years the men whose job it is to remove motor pulleys find this device a smooth and rapid performer.

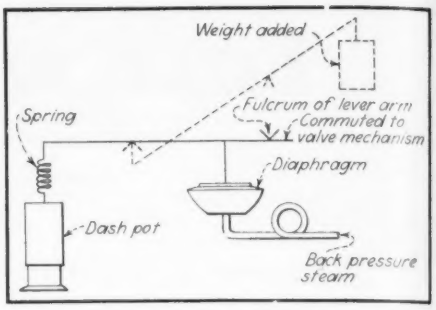
A couple of pieces of angle iron are bolted parallel to each other across the base of the jack cylinder. Another pair, parallel to the first, are fastened across the other end of the cylinder. A pair of channel shapes form the sides and to their ends are welded-shaped pieces of steel sheet to form the jaws of the puller. The side channels are held by hinge rods between the ends of the pair of angles across the base of the jack. The angles at the other end of the cylinder serve as guides for the opening and closing movements of the jaws.

Control Revised for Lower Back Pressure

By C. E. CUSHING
Northern States Power Company, Minot, N. D.

Responding to changes in the district heating load supplied with exhaust steam from the power plant at Minot turbine back pressures may go as low as two pounds. Since the turbine valve mechanisms are designed for use at a back pressure of the order of ten pounds or so, operation at the lower pressures was not entirely satisfactory. When the back pressure drops so does the lever operating the valve mechanism, but its movement is restrained by the dashpot. With the extremely low back pressures the action was too slow, and the turbine did not supply steam to the load in properly regulated quantity.

Quicker response to sudden rises in the low back pressure range was accomplished by the added detail shown by the dotted line. It involves an auxiliary lever whose fixed weight is always ready to assist the upward movement of the steam-pressure diaphragm. The downward movement is, of course, resisted, but the slower response to decreases in back pressure is not so objectionable.



Added weight aids operation at lower exhaust pressure

Compact Table Shows Monthly Voltage Data

SERVICE VOLTAGE MEASUREMENTS
Month of August 1935

Time of Day	Voltage	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	
	12P-1A																																-
	1A-2A																																-
	6A-7A																																
	7A-8A																		1														1
	8A-9A																			1	1												2
	9A-10A																	1	1	2	1	1											6
	10A-11A																	1	4	5	1	1											12
	11A-12M																	1	1		1												4
	12M-1P														1					5	3												9
	1P-2P																		1	2	3												6
	2P-3P																	1	1	3													5
	3P-4P																	2	6	3	2												13
	4P-5P																	3		1		2	1										7
	5P-6P																		3	4	2	2											11
	6P-7P																1	5	2	3	3												14
	7P-8P																	5		3	1	1		1									11
	8P-9P													1						2	3	1											7
	9P-10P																	1	2	1	1												5
	10P-11P													1																			1
	11P-12P																																
	Totals													2	1		1	21	24	36	20	7	1	1									114

TheEEICo.ofB. Form X1293 Towns: X

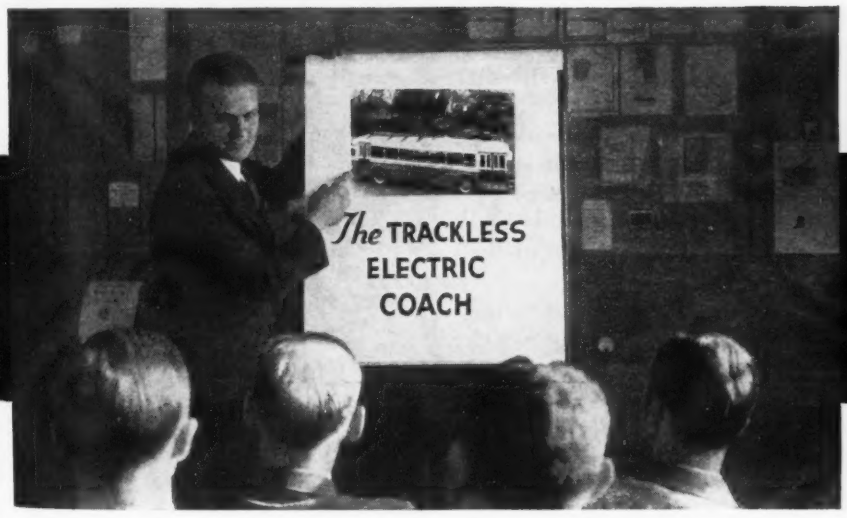
To enable voltage conditions checked on service calls to be summarized for quick reference each month, the Boston Edison Company tabulates the data from each town on the system on 8x11-in. sheets as illustrated. Tests are made by each troubleman as he visits a customer's premises and the voltage readings and time of day are turned in to the office for summary. Abnormal conditions are referred to the electrical engineering department for investigation.

In the typical town shown the normal potential is 117 volts at the service entrance switch, the permissible variation being between 112 and 122 volts. For the month taken, out of 114 voltage readings made on service calls in town X, 101 ranged between 116 and 119 volts inclusive, only one was above the maximum value and two below the minimum. The caliber of the regulation is indicated by the values obtained at different times of day and the data substantiate the findings of the special commission appointed by the Governor to study various utility matters, viz., that very little excess voltage capable of materially increasing bills or of shortening lamp life prevails in the Boston area.

ARE YOU LETTING THE BIG ONES GET AWAY?

ONE SALE

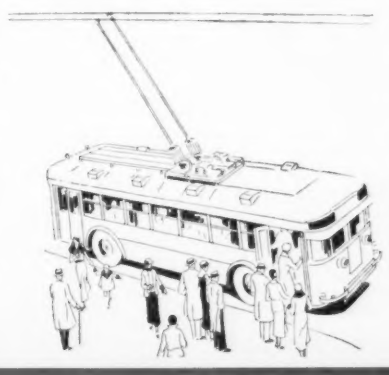
500 kw-hr a year



ONE SALE

100,000 kw-hr a year per vehicle

SELLING 100,000 kw-hr per unit is a good sale (especially when it brings a civic improvement—modern electric transportation). Selling the trackless-trolley idea to transit companies means that much load on your lines per vehicle. Stopping a vast drop in your power load is a good sale. Electric-service companies face a loss of transportation-power load running into billions of kw-hr if transit operators continue to substitute gasoline for electric motive power. We recognize the importance of appliance-load building, and concerted effort is putting it over. Have you ever considered the trackless-trolley load in terms of equivalent appliance revenue? If not, it's time to do some figuring—time to put "transportation" on your selling program.



Sufficient operating records are available to prove that the electric coach is a money-maker, besides being a load builder for you. These facts will help you in discussing it with transit operators, with civic leaders, or with your own people. Consult your G-E office. General Electric Company, Schenectady, N. Y.

GENERAL ELECTRIC

POWER AT WORK IN INDUSTRY

New ideas and practices in industrial electrification as presented by industrial, consulting and power sales engineers

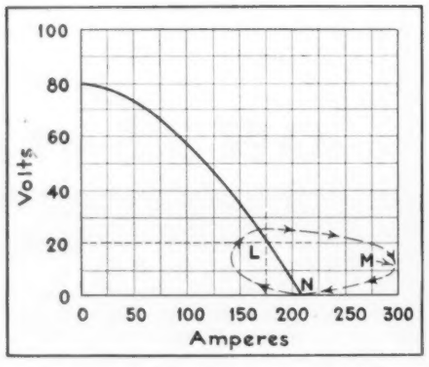
Constant Current Cuts Welding Costs

Tests, run with a view to evaluating the effects of welding generator characteristics on welding costs, indicate that generators with steep static characteristic curves (nearly constant welding current) deposit 5 to 12 per cent more metal per kilowatt of generator output than other designs, according to J. H. Blankenbuehler in a paper recently presented before the American Welding Society. Improved deposit efficiency and increased deposit on an hourly basis were also reported.

The tests, conducted by the Westinghouse Electric & Manufacturing Company, compared the costs of welding with generators giving nearly constant welding current and conventional unimproved generators. All welds made were multiple-pass, butt welds between thick plates. Between 3½ and 4 lb. of metal was deposited in each run, involving 20 to 50 welding rods. Relay-operated electric clocks recorded welding time.

Among the principal factors considered in the study of welding costs for the different generators were: Pounds of weld metal deposited per hour, pounds of metal deposited per kilowatt-hour consumed by the set and pounds of metal deposited per pound of welding electrode purchased. In addition deposit efficiency was determined for the units tested. It is the ratio of the increase in weight of the plates welded to the weight of the rod melted, exclusive of the weight of the stubs.

Results of tests are shown in the accompanying table. Welding sets 1 and 3 are of the improved type as is indicated by the low values of the excellence factors. With sets 1 and 2, which have the same efficiency, the improved generator saved power. With sets 3 and 4, however, the greater electrical efficiency of set 4 overbalanced its generator's inferiority and gave the least power cost. It will be noticed that the deposit efficiency for the improved units is uniformly higher than that for the conventional generators.



Static and transient characteristics for welding generator

Generator inductance prevents voltage and current changes from keeping step with change in arc conditions. Thus instead of changing as shown by static characteristic curve (solid), welding current may change as indicated by arrows which indicate transient characteristics.

Effect of Constant Welding Current on Welding Efficiency

Comparison of the current characteristics of the various generators was facilitated by the use of an empirical "excellence factor" which was set up to give an indication of current constancy during the welding operation. This factor "C," which is a minimum when welding current is constant, is the product of two other factors "A" and "B." Referring to the illustration, which shows the static and transient characteristics of a 200-amp. welder, factor "A" is the ratio of short-circuit current to welding current ($A = N \div L$). Factor "B" is the ratio of maximum current surge on short circuit to the final steady short-circuit current ($B = M \div N$), as determined from the transient characteristics shown dotted in the illustration.

Type of Electrode	Welding Set	Excellence Factors A	B	C	Amp.	Volts	Pounds of Weld Metal Deposited: Per Hour	Per Ampere-Hour	Per Kw.-Hr. Generator Output	Per Kw.-Hr. Motor Input	Deposit Efficiency
No. 1 Heavy flux..	1	129	100	129	306	28.3	5.8	0.0190	0.673	0.361	63
Coated ⅛ in.....	2	131	325	425	296	29.7	5.71	0.0193	0.646	0.354	59.9
No. 2 Heavy flux..	1	139	100	139	282	34	6.83	0.0242	0.710	0.412	64.3
Coated ⅛ in.....	2	142	325	461	271	35	6.45	0.0242	0.681	0.404	63
No. 1 Bare.....	3	150	190	285	196	15.5	3.68	0.0187	1.235	0.441	94
$\frac{1}{16}$ in.....	4	125	345	431	194	16.5	3.51	0.0181	1.104	0.484	89
No. 2 Bare.....	3	155	190	295	204	13.8	3.12	0.0153	1.108	0.372	92
$\frac{1}{16}$ in.....	4	121	345	418	198	14.7	2.95	0.0149	1.018	0.425	89.5

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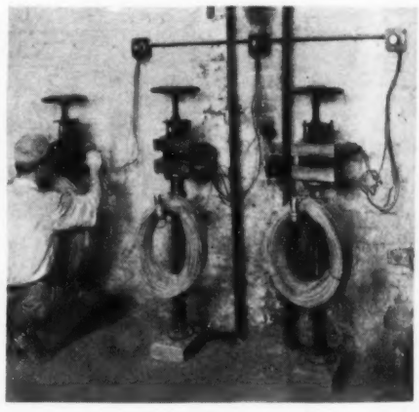
Electric Vulcanizing Mends Insulation

Small defects in the rubber covering of wire and cable which are detected in the course of routine production



Electrically heated vulcanizers repair damaged rubber covering on wire

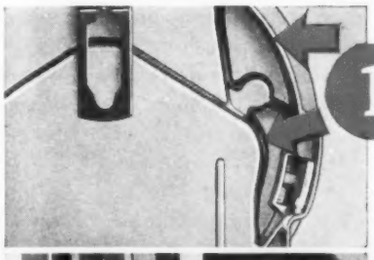
testing are "patch vulcanized" with electrically heated vulcanizing platens at the plant of the Bishop Wire & Cable Company, New York City.

After defects are detected and marked they are wound with several turns of raw rubber tape and inserted in the vulcanizers. These units, of which there are three, consist of two platens grooved to receive various sizes of wire that are driven together by hand wheels. Localized heat is applied to the platens by two sheathed 200-watt cartridge heaters controlled by a three-heat switch. Electric service is supplied by the New York Edison Company, Inc. The vulcanizing operation process requires about three minutes at approximately 250 deg. F.

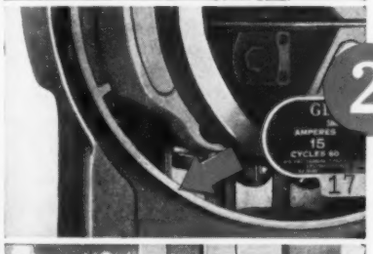
Although this work can be and formerly was done with steam, this manufacturer states that the change was

7 NEW FEATURES *of the* I-20 Meter Line

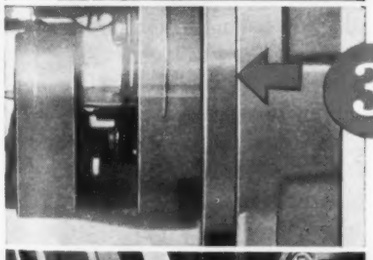
TYPE I-20-A



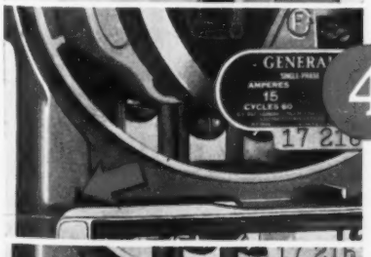
1 Double-walled meter base, which extends out around the base of the glass cover. It makes energy diversion more difficult.



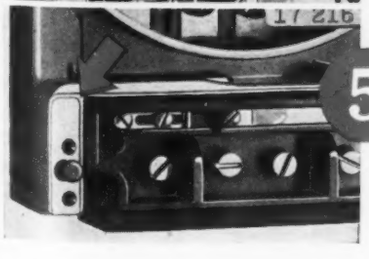
2 Greater gasket-bearing surface, which improves the seal between the glass cover and the base.



3 Increased height of flange which overlaps the cover rings around the outside of the base. This makes the glass-cover-base seal more weather-resisting.



4 Drain hole on the upper side of the terminal chamber, which prevents accumulation of water.



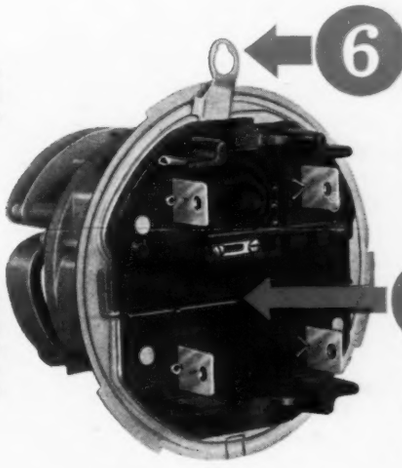
5 Added beads on the cover flange around the terminal chamber, which improve the seal between the connection-box cover and the terminal chamber.

THE Type I-20-A is the General Electric bottom-connected, single-phase watthour meter. To provide additional protection, five improvements in details have recently been made. These are illustrated and described at the left.

Improvements have also been made in the Type I-20-S, which is the General Electric socket-type, single-phase watthour meter. These new features provide greater convenience and additional insulation. They are shown below.

In addition to watthour meters and accessories General Electric is now in a position to furnish tamperproof service cable, in three designs, and such fittings as straps, supports, and hooks.

Detailed information on watthour meters is given in Bulletin GEA-1898, and on service cable in GEA-1791. For copies address the nearest G-E office or General Electric Company, Dept. 6B-201, Schenectady, N. Y.



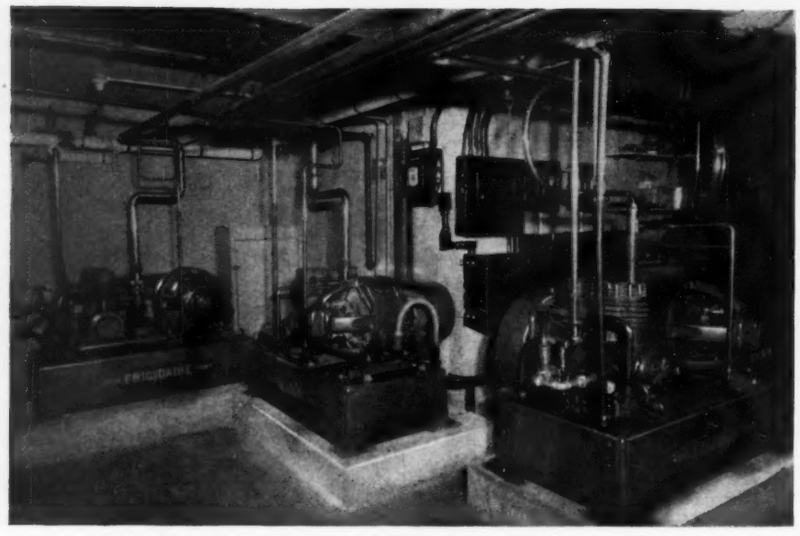
6 A hanger at the top of the base-plate assembly, which can be used to store meters on test-department racks, and which can be swung down into a recess in the base when the meter is placed in service.

7 A new base-plate assembly, which consists of a Textolite terminal plate riveted to a skeleton metal baseplate with a cork gasket between them. It improves the dielectric and mechanical strength.

TYPE I-20-S

400-16

GENERAL ELECTRIC



Air-cooling units compactly installed beside basement walls of a café where space was at a premium

Each has a refrigerating capacity of 10.5 tons per 24 hours. Two units serve the upstairs café and one the ground floor dining room, the refrigerant being piped to cooling coils in the duct system through which the incoming air is circulated before entering the dining rooms. One 2-hp. motor-driven fan serves the upper dining room, 6,300 sq.ft., and two 1-hp. fans serve the street floor café, the fans being used in winter to force warm air into the rooms after it leaves steam coils mounted in the chambers containing the cooling coils.

made to electric heat because it was cleaner and permitted more accurate temperature control.

•

Air-Cooling Units Provide Load

Desirable summer load for the Boston Edison company and a patronage builder for the Patten Restaurant at 39 Court Street in that city has resulted from the installation of an air-conditioning equipment. The restaurant is housed in a two-story building with a flat roof having a surface exposure to the sun of about 8,700 sq.ft. and has an upstairs dining room seating 400 and a street floor dining room accommodating 150. To insure comfort in the upstairs dining room under this heavy sun exposure the installation was figured to provide a temperature of about 80 deg. F. at 50 per cent humidity, with an outside maximum of 95 deg.

Three duplex Frigidaire compressors, each individually driven by a 10-hp., 230-volt, direct-current motor running at 1,750 r.p.m. have been installed, as shown in the illustration at the top of this page.

Watt-hour meter records for a year showed a total energy consumption for the compressors used in air conditioning of 19,946 kw.-hr., or 36.2 kw.-hr. per seat-year. It is estimated that about 2,000 additional kilowatt-hours were consumed in driving the fans during the air-conditioning season, making a total of roughly 40.0 kw.-hr. per seat-year for this complete service. The monthly consumption of energy for compressor operation ranged from 128 kw.-hr. in March to 6,728 kw.-hr. in August. In June, July, August and September the energy consumptions for compressors totaled, respectively, 1,938, 5,006, 6,728 and 3,604 kw.-hr. The air supply rating of the fans is about 15,000 cu.ft. per minute. Total energy consumption of the restaurant for all purposes, including electric kettles, miscellaneous power, lighting and air conditioning, in a recent twelve months was 145,886 kw.-hr. The air-conditioning load increased the usage of energy by about 15 per cent, and this has been a potent factor in drawing business to the establishment.

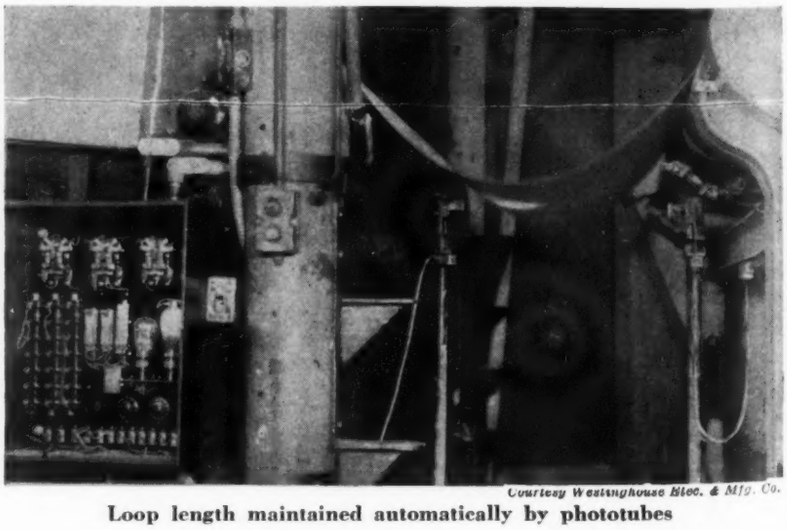
•

Phototubes Section Paper Coater Drive

Considerations of lower maintenance, elimination of bulky mechanical drives and improved efficiency that have influenced the selection of sectional drive to paper machines were also instrumental in the application of individual motors to a paper-coating machine of the West Virginia Pulp & Paper Company at Piedmont.

Each section of the machine, namely, coating rolls, brushing unit, drier, pull rolls and reel, is driven by a Westinghouse adjustable speed d.c. gearmotor with proper control for obtaining inching, threading-in and the different normal operating speeds.

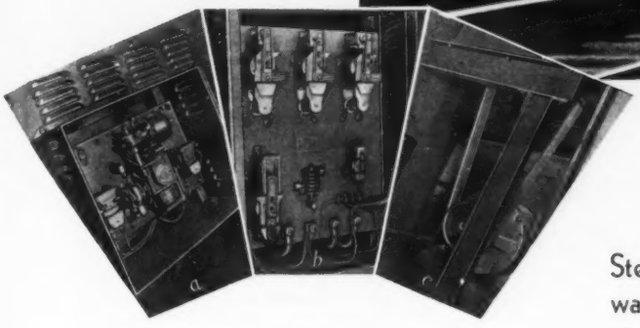
There are two special features of this drive deserving of special mention. The loop that must be maintained between the coating rolls and drier section is maintained automatically by photo-electric control, no mechanical system of control being permissible due to the wet condition of the sheet. If the loop becomes too long the drier motor is speeded up, while if it becomes too short the drier motor speed is reduced. The motor driving the pull rolls has a double function, operating as a motor part of the time and as a generator most of the time to provide a constant tension on the coated paper as it is reeled. A tension regulator on the reel motor will assure constant paper tension throughout the winding operation.



Courtesy Westinghouse Elec. & Mfg. Co.

Loop length maintained automatically by phototubes

MONITOR AUTOMATIC CONTROL *for Tunnel Ventilating Fans*



"a" Timing relay and track control unit.
"b" Controller of 50 H. P. fan motor.
"c" Interior of fan room between tracks.

AN INTERESTING APPLICATION OF AUTOMATIC CONTROL –

Steam motive power is used to operate trains in the railway tunnel under the streets of St. Louis. The resulting smoke and steam must be removed by exhaust fans or the tunnel rapidly becomes impassable. Motor driven fans are used to clear the atmosphere but if run continuously the expense is excessive.

Through the use of Monitor Controllers, interlocked with track circuits of the signal department, a rather ingenious scheme has been worked out so that the tunnel fans start when a train enters the rail section controlling the fans, and through the use of a Monitor "Work-cycle" timer the fans continue to operate for ten minutes after the last car has passed beyond the track control section. . . . The control is further arranged so that it will immediately recycle if another train enters the controlling section in either direction before the elapse of ten minutes, and is arranged to permit repetition of this cycle as needed. This is just another example of the "special" type of control apparatus MONITOR is so well equipped to furnish. Standard Monitor units were used throughout, especially assembled to meet the requirements of this particular application.

Monitor

The Original Just Press a Button System

AUTOMATIC ELECTRIC MOTOR CONTROL

We build a wide range of standard controllers, starters and accessories—all illustrated and described in the new Monitor catalogue. . . . Custom built apparatus by special assembly of standard parts is available at prices comparable with those of ready-made equipment. Monitor sales representatives in principal cities will gladly consult with you. Write us.

MonitorControllerCompany

Gay, Lombard and Frederick Sts.
BALTIMORE, MARYLAND

NEW ENGINEERING IDEAS

Discoveries, proposals and developments by electrical engineers and scientists in the field, the factory and the laboratory

Oscillograph Device Speeds Transfer

By F. S. BENSON
Pacific Gas & Electric Company,
San Francisco, Calif.

To observe the performance of two 50,000-kw. vertical compound turbine generators which were installed a few years ago for the Pacific Gas & Electric Company at station "A," San Francisco, during short circuits on the 12-kv. system, one six-element, high-speed oscillograph was purchased and installed in the switchboard room at this station. As only one oscillograph was available for two machines the operator had to be provided with equipment to transfer quickly the connections from the galvanometer elements to either of the two sets of generator instrument transformers.

To this end the company designed and installed a transfer equipment assembly consisting of two meter test receptacles and one test plug. Each receptacle assembly consists of a sheet metal container with a hinged cover. Inside each box is a terminal strip and a six-pole meter test receptacle. The terminal strip, consisting of twelve terminals, is used to connect the leads from the generator instrument transformer to the receptacle. A six-pole plug connected to a flexible multi-conductor cable was supplied to connect either set of generator instrument transformers to the oscillograph elements. The plug is built from a six-pole meter test plug and is covered with sheet bakelite and supplied with handles at each end to aid in removing it from the receptacle. The metal box door when closed and locked prevents the plug from slipping out of the receptacle contacts.

The oscillograph is started by a predetermined excess current through the generator neutral current transformer. These transfer assemblies have been in operation for a number of years and have proved very simple to operate, and their installed cost was quite low.

•

Compares Costs of Gas vs. Electricity

By NORMAN B. FOSTER
University of North Carolina,
Greensboro

Determination of the point at which it is economically justifiable, from the viewpoint of operating costs, to change from a gas to an electric range is of universal interest. The many variables prevent anything but a general solution, the procedure of which is described.

Since the heat content of a kilowatt-hour is a constant (3,415 B.t.u.) it is possible to reduce the cubic feet of gas (540 B.t.u. average assumed) to equivalent kilowatt-hours of electricity for comparison. There results, by division, a factor (0.158) which is the theoretical kilowatt-hour equivalent of a cubic-foot of gas. According to a nationally known testing laboratory, the gas range will, however, consume about 1.84 times as much heat as an electric range in doing the same cooking job. Dividing the previously obtained kilowatt-hour equivalent of a cubic-foot of gas (0.158) by 1.84 will produce a factor (0.086) which can be used to convert gas range input, in cubic-feet, into equivalent electric range input in kilowatt-hours.

If the electric rate decreases with increased consumption, the cost of operating an electric range will depend largely on how much current is used in addition to that used by the range. In this case add the kilowatt-hours calculated for the electric range to the average monthly use of electricity for lights and other appliances. From this total the all-electric bill can be determined from the appropriate electric rate block. The electric range operating cost

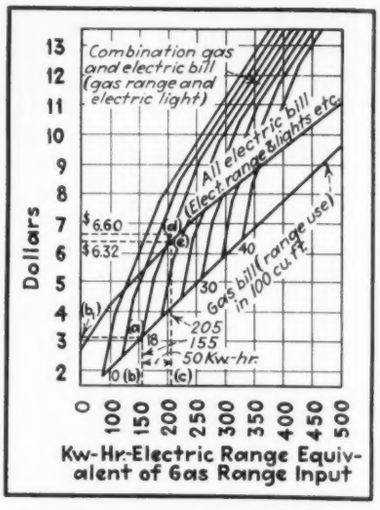
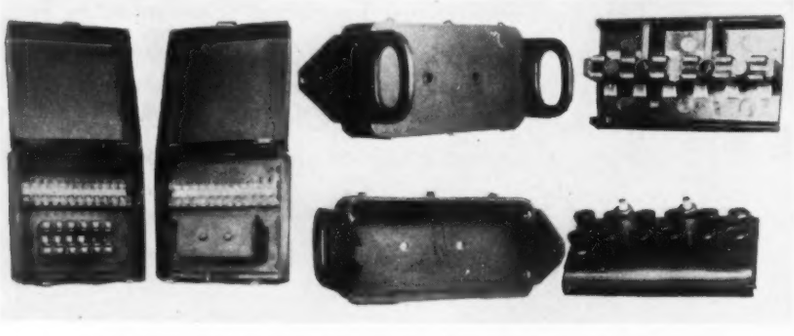

Combination gas and electric bill (gas range and electric light)
All electric bill (Elect. range & lights etc.)
Gas bill (range use) in 100 cu. ft.
Dollars
$6.60
$6.32
205
155
50 Kw-hr.
Kw-Hr. Electric Range Equivalent of Gas Range Input

Chart for comparing operating cost of gas and electric ranges

Compare operating cost of electric range and gas range, for example case where gas consumption is 1,800 cu.ft. and electric consumption 50 kw.-hr. per month. Enter chart at point (a), corresponding to use of 1,800 cu.ft. of gas. Read gas cost at (b_1) of $3.10 and equivalent electric range input at (b) of 155 kw.-hr. To 155 kw.-hr. add monthly use for lights and appliances of 50 kw.-hr., giving 205 kw.-hr. Intersection, at (d), of the 205 kw.-hr. line with the curve originating at (a) gives the total cost of gas and electric service as $6.60 for local rates. Intersection of 205 kw.-hr. line with all electric bill line, at (a), gives a corresponding bill for both electric range and lighting as $6.32. The saving resulting from use of all electric range is $6.60—$6.32 or $0.28 per month.

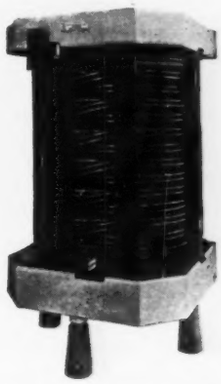


Special receptacle provided to transfer oscillograph connection from one generator to another

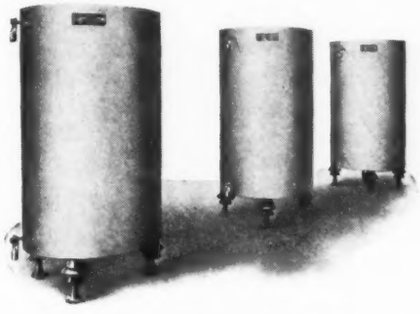
Left, receptacle itself; (right) two close-up views of plug and cover. The receptacles are built with four current transformer contacts and two potential transformer contacts, which allow the oscillograph to be connected to and record "A," "B" and "C" and generator neutral currents, A to B phase and A to C phase potentials.

1336 K.V.A., 4060 Ampere, 11.4 K.V., 25 cycle indoor service, open type, fireproof construction.

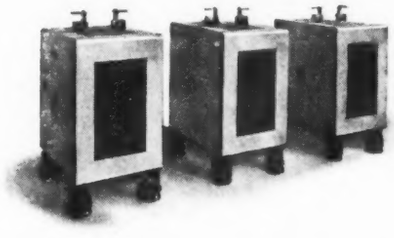
Special fuse testing reactor. Maximum short time rating 3000 Ampere, 12 K.V., 60 cycle, 6 tap variable reactance.



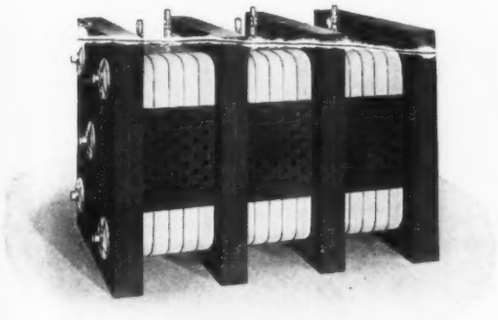
1125 K.V.A., 3000 Ampere, 12 K.V., 60 cycle indoor service, open type, fireproof construction, special design to meet customer's space allotment.



277 K.V.A., 600 Ampere, 16 K.V., 50 cycle outdoor service, dry type, all enclosed reactors.



162 K.V.A., 500 Ampere, 6.6 K.V., 25 cycle indoor service, enclosed type, fireproof construction.



36 K.V.A., 100 Ampere, 4.15 K.V., 60 cycle, 3 phase indoor service, enclosed type, fireproof construction.

MURRAY LOW LOSS REACTORS

Dry type reactors for line voltages up to 33 K.V. for indoor or outdoor installation—as large as 5,000 amperes. as small as .4 K.V.A.

When in need of reactor protection send us your inquiries.

Efficiencies guaranteed.

Metropolitan Device Corporation
Brooklyn, N. Y.

PARTIAL LIST OF INSTALLATIONS

Northern States Power Co.
New England Power Co.
Long Island R. R. Co.
Pan American Petroleum Co.
Westchester Lighting Co.
Shawinigan Hydro Elec. Pr. Co.
Bronx Gas & Electric Co.
Carnegie Steel Co.
Utica Gas & Electric Co.
Standard Oil Co.
Calco Chemical Co.
Brooklyn Edison Co.
Consol. Gas, Elec. Lt. & Pr. Co.
Edison Electric Illuminating Co.
Interborough Rapid Transit Co.
N.Y. & Queens Elec. Lt. & Pr. Co.
Hydro Electric Pr. Comm. of Ont.
Victoria Falls & Transvaal Pr. Co.
Havana Elec. Light & Power Co.
New York Power & Light Co.
Cataluna Power Co., Spain
Northwestern Electric Co.
Southern California Edison Co.
Stone & Webster Properties
New York Dock Co.
Potomac Electric Co.
Tennessee Power Co.
United Electric Light Co.
Union Gas & Electric Co.
Yonkers Electric Lt. & Pr. Co.
Dayton Power & Light Co.
Commonwealth Edison Co.
Detroit Edison Co.
New York Edison Co.
Philadelphia Electric Co.
Southern Wisconsin Pr. Co.
Kansas City Pr. & Lt. Co.
Syracuse Lighting Co.
Columbus Ry. Pr. & Lt. Co.
Public Service Co. of No. Ill.

will then be the difference between the all-electric bill and the cost of lights and appliances.

The accompanying chart shows graphically the points at which total bills for combination gas and electric usage just equal bills for all electric usage under a particular pair of rates. Modification to fit gas and electric rates in other communities can easily be made.

•

Line Uses Mountain Side for Towers

By V. H. STRANDBERG
Associate Engineer,
Seattle City Light Department

When the U. S. Forest Service decided to built a road up the Skagit River canyon a new problem was presented to the engineers of Seattle's City Light Department. For almost a mile the road was to be hewn out of a rock cliff closely paralleling the location of the city of Seattle's Skagit River Railway and 165-kv. transmission line from its hydro plants on the Skagit. A perpendicular precipice on the other side of the river left no other alternative than this location.

The transmission line was supported over the railroad right-of-way on span wire construction. It is an important link in the power supply for Seattle and accidental outages which might result from blasting for the new road in close proximity to the line had to be avoided. Relocating approximately one mile of the line was the only solution and the only possible route for the new line was on the cliffs high above the railroad. This also presented a problem requiring considerable ingenuity.

Standard construction on this line consists of "H"-frame wood-pole towers at an average span of approximately 600 ft. The conductor is 477,000-circ.mil A.C.S.R. with spacing between wires of 15 ft. The line is insulated with ten units of 10-in. suspension disks in suspension positions and eleven units of 11-in. high-strength insulators in strain positions. Liberal use was made of four-pole strong towers throughout the line.

Where the relocated portion of the line rounded a point of the cliff the use of standard construction proved impossible because of the excessively high poles required and the necessity of blasting pole settings in hazardous locations high above the railroad and transmission line. Steel arms anchored and guyed to the cliffs solved the problem.

Novel construction used to support 165-kv. transmission line in Skagit River canyon

In this single instance the crossarm was mounted on a 10-ft. steel tripod to increase clearance to ground; normally the beams were anchored directly to the rock. The arms, 60 ft. long, consist of two 8-in., 11.5-lb. channels latticed together, forming a beam 18 in. wide. The inner or ground end is pin-connected to a 1⅛-in. × 4-ft. 0-in. bolt set in the rock. This also acted as a pivot, about which the arm was raised during erection. The outer end and mid-points are supported on a double ⅞-in., nineteen-wire, galvanized guy strand anchored to eyebolts set in the rock above. The arm was side guyed to prevent movement along the line. The entire structure was bolted together at the tower site.

All joints were pin-connected and all anchorages 1½-in. eyebolts. Guys were made up in the shop to calculated lengths. Field work was reduced to the drilling of holes, setting of eyebolts, bolting up the arms and lifting them into place, all done in less time than would have been required to blast the holes required for setting poles for the conventional three-pole angle towers required in these locations.

Conductors were cut and spliced to those already pulled into the new location. The new section of line was then sagged in and the splices made at the other end, after which the line was clipped in on the new towers. The entire transfer was made in less than twelve hours, despite the inaccessibility of the towers.

•

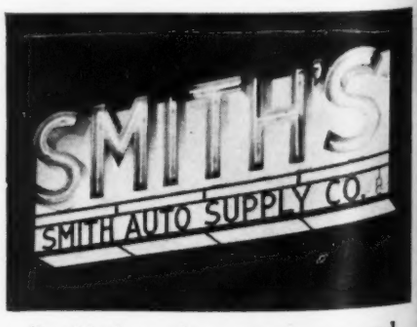
Opal Glass and Neon Make Effective Sign

By HOWARD M. SHARP
Lighting Sales Department,
Buffalo, Niagara & Eastern Power Corporation, Buffalo, N. Y.

An interesting and distinctive electric display sign consisting of an internally illuminated opal-glass box-type sign upon which the text message is silhouetted was developed jointly by the Kreiss Sign Company and the Buffalo General Electric Company to attract attention to the Smith Auto Supply Company, a store located in a highly competitive district of downtown Buffalo.

The main body of the sign is held together by a rigid angle- and tee-iron frame and is illuminated from the inside by lamps arranged as shown in the accompanying diagram. Neon letters built inside metal channels are fastened to the face of the box. Below the neon letters black metal letters giving the company name are placed directly against the glass and are visible nearly a block away.

Forty-eight 60-watt lamps in the interior of the sign plus 80 ft. of Neon tubing on the outside make up a total of 3,440 watts for the installation. The sign, in addition to filling its purpose as an attention-getter, serves also to illuminate the sidewalk and store front.



Double-face glass transparency and Neon tubes combined in store sign

Flashed opal glass background lighted by 60-watt lamps on 10x8⅝-in. centers. Neon tubing in trough letters 28 in. high with 4½-in. stroke. Over-all sign dimensions 10 ft. long, 3 ft. 6 in. high and 14 in. wide.

PRICES AND PLANS

"GET THE ORDER"

OPTIMISM is growing. Range merchandisers are preparing for a big year. Public Opinion has swung to electric cookery. Be prepared for a big year. But "GET THE ORDER" early.

Hotpoint offers a new line of Ranges and Water Heaters, New Sales Plans, Contests and Promotional Material that enable you to start merchandising *now* and keep it up all year.

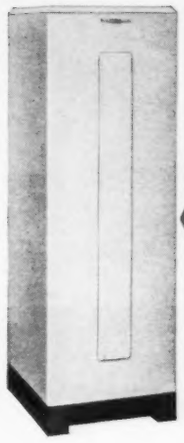
Ask the Hotpoint representative in your district for complete details about Hotpoint's dynamic "GET THE ORDER" Plan for 1936.

TWELVE MONTHS PROGRAM—Five separate activities, each complete with special material for each campaign, giving a well-organized year 'round activity.

NATIONAL ADVERTISING—Full page advertisements, many in color, in Saturday Evening Post, Ladies' Home Journal, McCall's, Good Housekeeping, and Better Homes and Gardens reach every other family in your community.

CLEAN SLATE SALES PLAN—For January, February, March the "Clean Slate" Sales Plan brings you complete equipment, including contests, window display, sales promotion material to help "GET THE ORDER."

Be sure to see the "Clean Slate" Plan Book. Look over the sales contest for retail salesmen and the mass of advertising material which can readily be adapted to your individual activity. It is easy for you to "GET THE ORDER" with this equipment.



HOTPOINT'S NEW LINE OF ELECTRIC WATER HEATERS

Hotpoint's new line of Water Heaters is complete. The popularly styled rectangular Vogue model is standard bearer and is now offered in sixteen different models. There are also six circular type heaters. Many sizes are available with monel metal tanks which are guaranteed for 20 years. Now you can "GET THE ORDER" for electric water heaters no matter what size heater is required.

WATER HEATER SALES PLAN—Here is the Old Faithful Plan Book—a completely organized selling plan—with samples of Hotpoint Water Heater sales promotion material, merchandising ideas, retail sales contest, newspaper advertising, direct mail, window displays, etc. Get in touch with the Hotpoint district representative in your territory.

ELECTRIC **Hotpoint** AUTOMATIC

RANGES AND WATER HEATERS

GENERAL ELECTRIC APPLIANCE CO., INC., 5612 W. TAYLOR ST., CHICAGO

They must be ECONOMICAL

ELECTRICIAN: We want "SA" Series Brushes because they keep our maintenance costs low.

● Operators of electrical equipment watch overall costs—machine maintenance as well as brush cost. They specify "SA" Series Brushes because the five grades, with graduated performance characteristics, permit selection, for every machine, on the basis of good commutation, good brush life and low maintenance expense.

● "SA" Series Brushes are designed, primarily, to meet the severe demands of heavy duty service. This they do, successfully and economically. They also insure economy in the operation of all types of commutating equipment adapted to the use of electrographitic grades.

There is a National Pyramid Brush for every class of service

NATIONAL CARBON COMPANY, INC.
Carbon Sales Division, Cleveland, Ohio
Unit of Union Carbide UCC and Carbon Corporation
Branch Sales Offices: New York Pittsburgh Chicago San Francisco

As One Merchandiser to Another

[*Continued from page 37*]

less per unit than is invested in existing capacity. At this point it may be well to emphasize the fact that this discussion is concerned only with the internal economy of the system and not at all with rates and service which affect the outside world. The benefits of system growth and of operating improvements realized from intelligent load building will of course appear in reduced rates and bettered service, no matter how merchandising costs are figured or if they are not figured at all.

In order to determine the capacity responsibility of new load, diversity factors, load factors and other considerations must be taken into account. Obviously a range with seven kilowatts of heating units in it will not require seven kilowatts of new plant capacity to serve it.

Out of the earning of each range, water heater and refrigerator* must come money for taxes on and for retirement provision for the new capacity each will require. Next will come production cost of the energy the appliance uses and the accompanying additional system expenses related to energy in conversion, transmission, distribution and utilization. There are also additional operating expenses that are related to gross revenue, such as general commercial expense, provision for bad debts and general office expense. The sum of all these is the annual cost to serve the new load.

The difference between the E A R of a particular appliance and the cost to serve it is the net return. But this return is not immediately available for system net. The cost of selling the appliance, the cost of merchandising, must first be paid off. How long it takes to do this is the measure of whether or not merchandising is worth while as a method of load building.

With the picture properly worked out and presented somewhat in the fashion of the accompanying example the sales head will have given his boss a convincing statement of cost of load building and will have shown that the load intended to be put on the line will be profitable.

*Although the reasoning of this discussion covers all appliances, it is impossible as a practical matter to apply it to any but the big three. The effect of load building from small appliance merchandising, though real, is a plus value that cannot be exactly determined.

Selecting Motors and Controls for Large Fans

[*Continued from page 28*]

put strains on the drive not found with the single-speed, low-inertia fan and thus require a higher load or safety factor in figuring the drive.

Synchronizing requirements

With synchronous motors and high inertia fans another starting problem has to be considered and that is the ability of the motor to synchronize the load. Before the field of a synchronous motor is excited the motor is running as a squirrel-cage motor with a slip depending upon the load and motor design. When the field is excited the rotor is locked into step or synchronism almost instantly. The inertia must be accelerated in this same short time. For high inertia this requires a low slip or a high synchronizing torque. The formula for determining the maximum synchronous motor slip to assure synchronizing is as follows:

$$S < \frac{590}{N} \times \sqrt{\frac{P_m}{WR^2/f}}$$

Where S = Slip in decimal; N = R.p.m. synchronous speed; P_m = Pull-out torque in k.w.; f = Rated frequency.

EXAMPLE: A ventilating fan of 5,200 WR^2 is direct driven by a 150-hp., 360-r.p.m. synchronous motor having a pull-out torque of 195 kw. and WR^2 of 2,400 lb.-ft.^{2}

$$S < \frac{590}{360} \times \sqrt{\frac{195}{7{,}600 \times 60}} = 0.034.$$

Themotor slip must therefore be less than 3.4 per cent.

Since standard synchronous motors are generally designed for 5 per cent slip at pull in (maximum induction speed for guaranteed torque) the above conditions would require a different design to reduce this slip or else an oversized motor to secure the same results. Failure to synchronize immediately causes line disturbances due to the motor slipping poles. A fan load might synchronize finally, though it would be more likely to run at subsynchronous speed, but other types of load would probably stall the motor.

•

Reich Electrifies Railway

The $285,000,000 electrification of 271 miles of the German State Railroad was recently started. Covering the Nuremburg, Halle-Leipzig section, a portion of the road which runs through mountains at fairly heavy gradients, the project will connect the already electrified lines in Bavaria and those in central Germany.

...WHICH MEANS AN INCREASED COMMERCIAL LOAD AND A MORE SATISFIED PUBLIC...

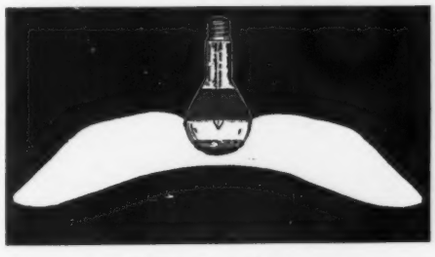
Any increase in street lighting is invariably followed by a corresponding upswing in the Business of the community . . . for people shop more on well-lighted streets. Increased business encourages better lighted store windows and better lighted store windows boost the Commercial Load.

Profitable, then, is the Silvray "Multiplex" Processing plan to increase *effective* street illumination from 30 to 50 percent . . . with present equipment . . . and at a cost equivalent to only about 10 percent of the annual street lighting revenue.

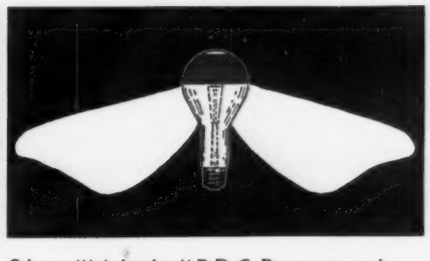
Write for details . . . or have one of our Engineers talk to you about a survey or recommendations. There is no obligation.

SILVRAY

"MULTIPLEX" PROCESSING



Silvray "Multiplex" B.U.S. Processing. Wide Range Symmetric Distribution. Base Up Burning Position.



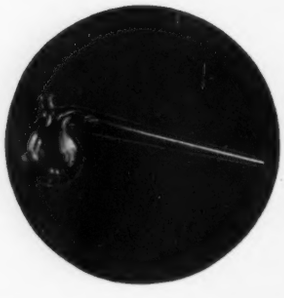
Silvray "Multiplex" B.D.C. Processing. Any Range Symmetric Distribution Base Down Burning Position.

AMERICAN STREET ILLUMINATING COMPANY

261 No. Broad Street Philadelphia, Pa.

"Backed by 58 years' Street Lighting Experience."

CHEMISTS WOULD CHOOSE *Pyrex*



Chemists DO choose Pyrex Laboratory Ware because of its high chemical stability, its resistance to thermal shock and high mechanical strength.

Insulators

• THE science of dealing with the constitution of matter finds much to commend Pyrex Insulators, since they represent an outstanding example of chemical stability and homogeneity.

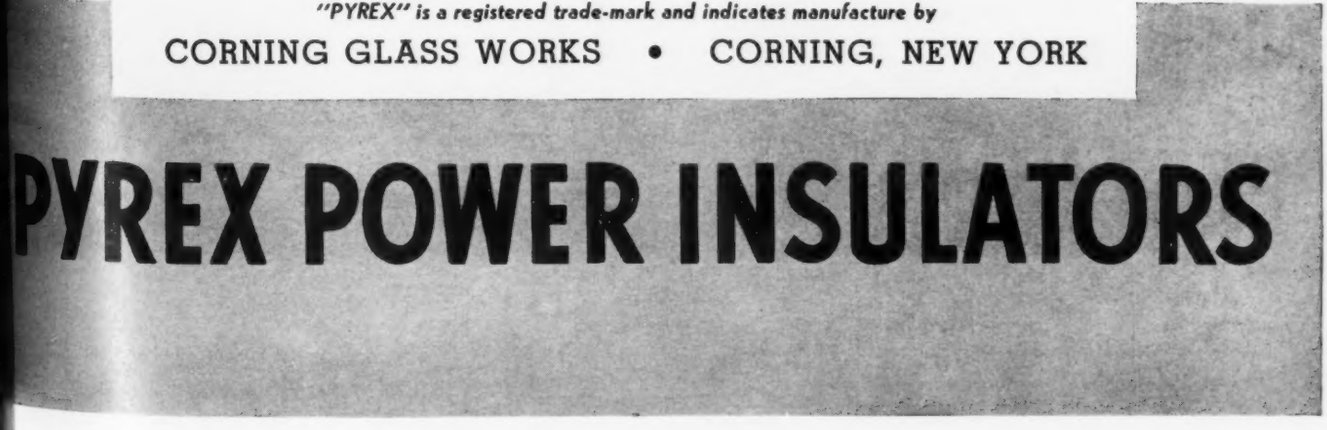
The compounding, fusing and working of definite proportions of specially selected raw materials gives to Pyrex Insulators unusual characteristics and produces one of the best insulators known. Unaffected by the attack of atmospheric impurities Pyrex Brand Chemical Glass is the ideal material for insulators.

Such qualities afford Pyrex Insulators the long-continued preservation of perfectly smooth surface that means clean insulators and generations of trouble-free service.

Under abnormal weather conditions Pyrex Insulators have long since proved their superior stability.

"PYREX" is a registered trade-mark and indicates manufacture by

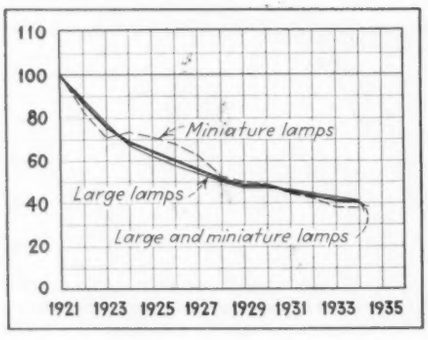
CORNING GLASS WORKS • CORNING, NEW YORK



BUILDING UP THE LOAD

New ideas and practices in selling electrical equipment and service to industrial, commercial and domestic customers

Lamp Prices Still Falling



Load building is being constantly facilitated by the steady decrease in the price of lamps, now lower than ever before. As shown in the annual trend chart issued by the Incandescent Lamp Department of the General Electric Company the average list price of large lamps in 1934 was only 41.1 per cent as high as in 1921. Miniature lamps were down to 37.7 per cent and both combined to 40.4 per cent. Christmas-tree and special lamps are not included in these figures.

With the average price of electricity for domestic use down to 72 per cent of the 1921 level, improved lighting has come within the means of more people than at any previous time.

•

Get Your Own Facts in Selling Power

By E. E. SCHWALM
Nebraska Power Company, Omaha

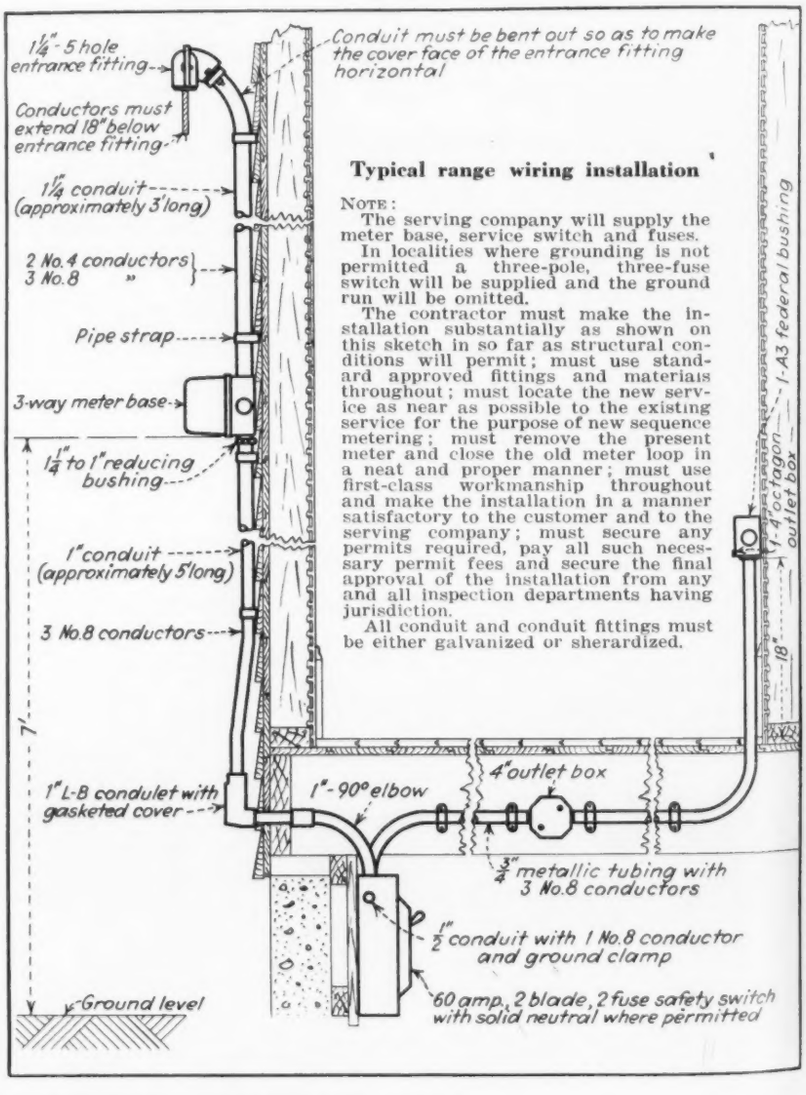
The importance of the accurate estimating of energy requirements for prospective power users was illustrated here recently. The cost of energy for a proposed new plant was estimated as accurately as possible on the basis of operating hours and operating conditions as furnished by a plant official during several discussions. On this basis the estimated bill was high and the prospective customer favored private plant generation.

Because there is no similar plant here, a trip was made to a plant in another city, where a thorough investigation disclosed many operating features not previously recognized. By means of this data it was found impossible to operate under the conditions that the customer had laid down and we proved to the customer that under average operating conditions the use of energy would be considerably less than estimated. He has signed a contract for purchased service and is now arranging all equipment for full purchased service operation.

•

Portland Utilities Push Free Wiring

In a free range wiring campaign organized by the two power companies of Portland, Ore.—the Portland General Electric Company and the Northwestern Electric Company—the company retains title to the wiring, which is done according to a standard hook-up. Work is rotated among the contractors and paid for on a flat rate of $23. The company furnishes the entrance switch box and fuses and the contractor all else. This wiring is represented to the public to be merely an extension of the heavy service wires to the point of heaviest use. One utility is capitalizing this cost of wiring. The other is charging it off as cost of selling. Before the nine weeks' drive was half over the dealers (80 per cent) and utilities (20 per cent) had sold 2,611 ranges against the quota of 1,200 set for the full term.

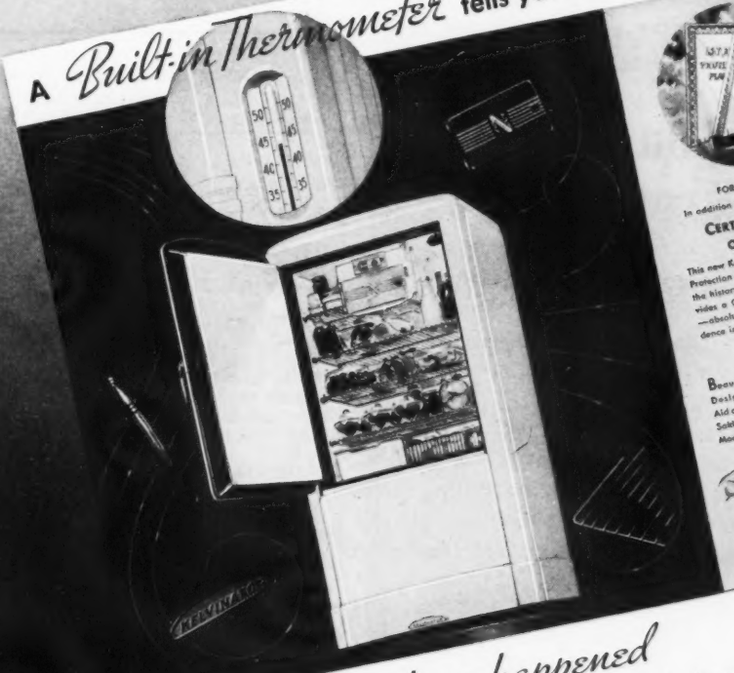

1¼"-5 hole entrance fitting
Conductors must extend 18" below entrance fitting
1¼" conduit (approximately 3' long)
2 No.4 conductors
3 No.8 "
Pipe strap
3-way meter base
1¼" to 1" reducing bushing
1" conduit (approximately 5' long)
3 No.8 conductors
7'
1" L-B condulet with gasketed cover
1"-90° elbow
4" outlet box
¾" metallic tubing with 3 No.8 conductors
½" conduit with 1 No.8 conductor and ground clamp
Ground level
60 amp., 2 blade, 2 fuse safety switch with solid neutral where permitted
Conduit must be bent out so as to make the cover face of the entrance fitting horizontal
1-4" octagon outlet box
1-A3 federal bushing
18"

Typical range wiring installation

NOTE:
The serving company will supply the meter base, service switch and fuses.
In localities where grounding is not permitted a three-pole, three-fuse switch will be supplied and the ground run will be omitted.
The contractor must make the installation substantially as shown on this sketch in so far as structural conditions will permit; must use standard approved fittings and materials throughout; must locate the new service as near as possible to the existing service for the purpose of new sequence metering; must remove the present meter and close the old meter loop in a neat and proper manner; must use first-class workmanship throughout and make the installation in a manner satisfactory to the customer and to the serving company; must secure any permits required, pay all such necessary permit fees and secure the final approval of the installation from any and all inspection departments having jurisdiction.
All conduit and conduit fittings must be either galvanized or sherardized.

Big things have Happened at Kelvinator!

A Built-in Thermometer tells you exactly how cold it is



FOR THE FIRST TIME . .
In addition to a 5-year Protection Plan
CERTIFIED LOW COST OF OPERATION

This new Kelvinator is backed by a 5-year Protection Plan; and for the first time in the history of the industry, Kelvinator provides a Certificate of Low Operating Cost—absolute proof of the Company's confidence in its product.

Beautiful Cabinets Designed with the Aid of Count Alexis de Sakhnoffsky, Famous Modern Designer.

All Ice Trays have Flexible Rubber Grids, Making Colder and Larger Cubes Instantly Accessible.

Big things have happened
Since you or your friends bought Refrigerators

Today there is a new electric refrigerator—far, far in advance of anything you have seen—or used or heard about—a refrigerator so different that many of the seven million present users of mechanical refrigerators will be ready to replace what they have with something infinitely better.

Scientific developments have resulted in a control of temperature amazingly accurate. For the first time, a built-in thermometer tells you exactly—in degrees—how cold it is in the food compartment. All possible doubt is removed.

Cost of operation has been reduced to a half and even a third as much as many refrigerators now in use. This cost is certified by the manufacturer so that you know what savings are possible.

And to give you more ice cubes—colder, larger and instantly accessible, at the refrigerator—it provides a flexible rubber grid in every ice tray.

With new beauty in exterior design, new convenience in interior arrangement, and features that have never before been offered—the 1936 Kelvinator introduces a new era in refrigeration.

Kelvinator dealers are ready to give you all the facts and tell you about the new Rediscо plan by which you can pay for Kelvinator out of the actual savings it makes possible.

KELVINATOR CORPORATION, DETROIT, MICHIGAN

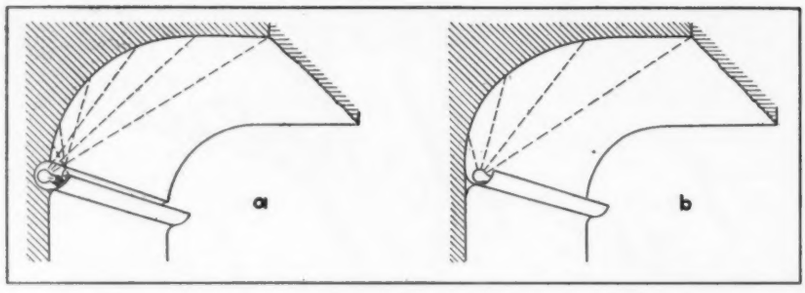
THE 1936 KELVINATOR IS THE ONLY REFRIGERATOR THAT OFFERS ALL THESE FEATURES

1. A built-in thermometer. . . . 2. A certificate of low cost of operation. 3. New beauty in design. . . . 4. 5-year protection plan. . . . 5. Flexible grids in all ice trays. . . 6. Interior light. . . . 7. Food crisper. . . . 8. Vegetable basket. . . . 9. Automatic defrosting switch. . . . 10. Sliding shelves.

A New High Standard of Modern Refrigeration

See the new KELVINATOR *Your next refrigerator*

Concentrate on Kelvinator in 1936!



Figs. 1a and b—Recommended change in cove design

(a) Recessed trough eliminates scallop effect and gives uniform illumination on adjacent areas.
(b) Pronounced scallop effects reveal lamp positions with this unrecessed trough fixture (not recommended)

Recessed Coves Improve Lighting

Architectural lighting is usually designed more for the esthetic appearance than efficiency, but engineers can often suggest minor changes which will increase its utilitarian value, declared C. S. Woodside, Westinghouse Lamp Company, speaking recently before the Illuminating Engineering Society.

A recessed cove, similar to that shown in Fig. 1(a), was recommended for use with the three most common types of lighting equipment—continuous source; discontinuous source and projectors. Used with continuous source lamps, this construction eliminates the area of high intensity adjacent to the cove, by partly shielding direct rays which are only permitted to strike the ceiling at a distance from the unit while the area close to the cove is illuminated by reflected light. A more uniform distribution results.

With discontinuous source lamps of the general service type the recessed cove does away with the scallop effect produced in the conventional trough fixture (Fig. 1(b)) by the dark space between the lamps. A uniformly lighted ceiling can be produced with general service lamps on 12- to 18-in. centers in a recessed trough fixture. Use of a mat white reflector is, however, considered essential.

The accompanying table shows results obtained in a test room with different types of lamps, coves and reflecting surfaces.

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Credit Earned by 2-Year Range Users

By W. C. MAINWARING
Merchandise Manager
British Columbia Electric Railway Company, Ltd., Vancouver, B. C.

A part of the British Columbia Electric Railway Company's 1935 sales plans, which include long-term, low-payment purchase of electric ranges, is a special inducement offer for customers who substitute electric ranges for coal or wood stoves. The electric ranges are sold on a cash or short-term payment plan by both dealers and the utility at the prevailing list price plus the regular wiring charge.

At the end of 24 months' continuous service, provided the customer's account is in good standing and the range purchase is fully paid for, the customer will have credited to his account $25. Sales made by dealers are likewise eligible to this offer, the credit being given to the dealer's customer after the range sold has been in service 24 months. A special form is provided dealers upon which to report sales so that the company can render the credit at the proper time.

The amount of the credit approximately equals the wiring charge paid by the customer and is expected greatly to assist load-building efforts of the industry in British Columbia.

•

Restaurant Units Sold on Load Basis

When a New England restaurant combined two dining places under one roof competition among fuel vendors against all-electric cooking became acute. The local power company made a survey and found that by supplying the energy for cooking on the low step of its regular rates the overall cost of electricity used by the concern for lighting, power and cooking would not exceed $500 a month. About 1,500 meals per day are served by the establishment. The owners decided in favor of electric service on account of its cleanliness, comfort in the kitchen and lower cost as compared with combinations that divided the cooking facilities between fuel and electricity. Four months' operation showed a total electric service cost within the $500 per month estimate.

Total connected kitchen load was 101.4 kw., with a maximum demand of 48 kw. occurring between 8 and 8.30 a.m. The restaurant is open 24 hours a day. Tests showed energy consumptions of various cooking devices to be as given in table above.

Energy Consumption of Cafeteria Units

Equipment	Length of Test in Days	Kw.-Hr. per Month
Charcoal type broiler (4 kw.)	9	609
Washing machine heater (3 kw.)	9	1,584
Coffee urn, 5-gal. (3 kw.)	5	396
Roll warmer, 2-drawer (750 watts)	5	174
Coffee urn, 5-gal. (3 kw.)	7	828
Dry kettle (4 kw.)	7	585
Steak griddle (4 kw.)	7	810
Steam table (7.35 kw.)	7	1,899
Vertical broiler (6 kw.)	7	600
Eight-slice toaster (5.5 kw.)	7	618
Bake oven (10.8 kw.)	14	1,755
Two ranges (32 kw.) and two 6-kw. meat roasting ovens	..	10,142
Average energy consumption per month, cooking service		20,000

Intensities Produced by Two Methods of Cove Lighting

Width of the room was 14 ft. with ceiling height 8½ ft. Reflection factors were 0.75 for the ceiling and 0.30 for the walls. In all cases the cove was installed along the two long sides of the room 20 in. below the ceiling.

Cove Construction	Reflector	Watts	Finish	Service	Spacing	Average Foot-candles
Fig. 1a	Pol. chromium	60	Clear	Lumiline	Continuous	13.5
Fig. 1a	Mat white	60	Clear	Lumiline	Continuous	13.6
Fig. 1b	Pol. chromium	60	Clear	Lumiline	Continuous	12.5
Fig. 1b	Mat white	60	Clear	Lumiline	Continuous	11.0
Fig. 1b	Translucent glass	60	Clear	Lumiline	Continuous	14.1
Fig. 1a	Mat white	60	Interior frosted	General	18 inch	18.5
Fig. 1b	Mat white	60	Interior frosted	General	18 inch	16.4

Recent Rate Changes

PACIFIC POWER & LIGHT COMPANY has been ordered by the Washington Department of Public Works to reduce its rates from 5 to 15 per cent. The total reduction, applicable to more than 32,000 south central Washington customers, amounts to $205,000 annually, and slashes residential rates 9 per cent, power irrigation rates 5 per cent and commercial rates 15 per cent. The order followed an investigation by the department, after which it valued the company's Washington properties at $11,466,600. The rates are divided into three classes, according to the size of the cities and towns served. The rate of return allowable on the company's investment is set at 7 per cent.

QUEENS BOROUGH GAS & ELECTRIC COMPANY has filed with the New York Public Service Commission a new rate schedule under which commercial consumers of electric power in Queens will obtain substantial savings. The commission has approved the new schedule. The revised rate applies only to consumers of lighting and power where the lighting connected load does not exceed 25 per cent of the total connected load. The charges under the revised rate are 8 cents per kilowatt-hour for the first 30 kw.-hr. per kilowatt of demand, 6 cents per kilowatt-hour for the next 90 kw.-hr. per kilowatt of demand (but not more than 500 kw.-hr.), 4 cents per kilowatt-hour for the next 180 kw.-hr. per kilowatt of demand (but not more than 1,000 kw.-hr.), and 2½ cents per kilowatt-hour for excess consumption. The minimum charge is $1 per kilowatt of demand, but not less than $2 per month. The charges under the superseded rate are 9½ cents per kilowatt-hour for the first 25 kw.-hr. per horsepower of demand, 6 cents per kilowatt-hour for the next 3,000 kw.-hr., and 3 cents per kilowatt-hour for excess consumption. The minimum charge of this rate is 50 cents per horsepower of full connected load, but not less than $2.

NEW YORK STATE ELECTRIC & GAS CORPORATION has promised voluntary reductions which would save consumers in Ithaca $40,000 a year, thus eliminating the necessity for a Public Service Commission hearing demanded by a city alderman last November. The new schedule was accepted by a special city hall committee, headed by Alderman Amos A. Barnes, instigator of the demand for lower rates. The company has filed with the commission a revision of electric rates which will mean an immediate reduction in residential rates to customers in the city of Plattsburg. The immediate reductions will save consumers $11,666 a year and further revisions to be effected next year will offer additional savings of $10,500 a year. Reductions in the annual general service rate are estimated to save consumers $15,150 annually.

INDIANA SERVICE CORPORATION has filed with the state Public Service Commission a petition seeking authority to readjust electric rates in Fort Wayne and adjacent territory. Residential users in Fort Wayne would not be affected, but commercial and small power users in the city and residential customers in contiguous territory would benefit. Company officials estimated the action would save users in Fort Wayne $30,000 annually and those outside the city $10,000.

LONG ISLAND LIGHTING COMPANY'S petition for a rehearing on a recent order directing it to cut electric rates sufficiently to bring about a saving of $1,225,000 to consumers, as compared with their bills for 1934, has been denied by the New York Public Service Commission.

DETAILS THAT MAKE WAGNER STUD-BUSHING-TYPE TRANSFORMERS SUPERIOR ARE:

Illustration of a 5 kva, 2400 to 120/240 volt, 60 cycle stud - bushing - type Wagner distribution transformer with a section of the tank wall cut away to reveal core and coils.

1. All coils are form-wound — thoroly dried and treated before assembling the core iron.
2. End-turns are extra-heavily insulated and definitely spaced to resist line disturbances.
3. Taps are brought out from the middle of windings where they do not interfere with the surge resisting design of the coils.
4. Core iron is built from non-aging silicon steel, specially manufactured for transformers.
5. Core iron laminations are cut with the grain of iron, the direction of which the magnetic flux encounters the least resistance.
6. All parts of the core and coils are completely immersed in transformer oil.
7. Tanks are formed of copper-bearing sheet-steel.
8. Tanks are electrically welded into an integral whole.
9. Tanks and covers are sandblasted outside and inside.
10. Every tank receives three coats of special transformer paint — selected for its adhesive and penetrating properties, its longevity, and its appearance.
11. Porcelain bushing flashover values coordinated with the transformer insulation strength.
12. Bushings are designed for easy removal without lowering transformer from pole or platform.
13. Tight-fitting bushings prevent syphoning of oil.
14. No solder is necessary for connecting transformers to line.
15. Transformers are shipped filled with oil, ready for service.

Write for Wagner Bulletin 172 which completely describes Wagner distribution transformers.

Wagner Electric Corporation
6400 Plymouth Avenue, Saint Louis, U.S.A.

TD336-1B

TRANSFORMERS MOTORS FANS BRAKES

MEN OF THE INDUSTRY

A. E. LaCroix Assumes New Executive Duties

▶ Arthur E. LaCroix has been appointed assistant vice-president of the New England Power Association, reporting to Arthur E. Pope, vice-president in charge of operation with headquarters at Boston. Mr. LaCroix entered the employ

A. E. LaCroix

Waid Studio

of the properties identified with this group in 1916, upon graduating from Cornell University, and has gradually become more and more closely identified with the economic administration of the hydro system, power contract problems and subsidiary managerial matters.

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C. F. Kettering to Receive 1936 Washington Award

Dr. C. F. Kettering, vice-president in charge of research, General Motors Corporation, Detroit, Mich., has been elected to receive the Washington Award for 1936. Selected from some 26 candidates, Doctor Kettering receives the award "as an outstanding engineer who has rendered pre-eminent services in promoting the public welfare through his outstanding contributions to the increase of personal mobility and his driving force for the cause of research as an instrument to increase the welfare and happiness of all mankind." The award, which consists of a suitably inscribed bronze plaque mounted upon a marble base, will be formally presented at a dinner to be held in Chicago, Ill., on February 27. Doctor Kettering is a fellow of the American Institute of Electrical Engineers.

•

▶ Miles E. Standish has been appointed sales manager of the Marble-Card Electric Company, Gladstone, Mich. Mr. Standish has had a rich experience in the marketing of electrical machinery. His former connections were with Louis Allis Company, Burke Electric Company and Imperial Electric Company. Mr. Standish received his education in electrical engineering at the University of Wisconsin.

▶ James Wilson, vice-president and secretary of the Shawinigan Water & Power Company, recently celebrated the 25th anniversary of his connection with the company and was the guest of honor at a luncheon in Montreal tendered by his fellow executive officers and associates in the company. The gathering was presided over by Julian C. Smith, president, who paid a high tribute to his valuable services.

▶ A. G. Schwager, formerly chief electrical engineer of the Pacific Electric Manufacturing Corporation, San Francisco, has been appointed chief engineer of that organization. Mr. Schwager, who is a native of Switzerland and a graduate of the Institute of Technology in Zurich, has been affiliated continuously with the Pacific Electric Manufacturing Corporation since 1926. His former connections include the Electrical Testing Laboratories in New York, the New York Edison Company and the Pacific Gas & Electric Company. Mr. Schwager has contributed frequently to contemporary technical literature, both through the trade press and through papers presented before the American Institute of Electrical Engineers.

•

F. L. Lovett

▶ Fremont L. Lovett, who recently was elected a vice-president of the Rockland Light & Power Company of New York and the Rockland Electric Company of New Jersey. His promotion was one of many changes in personnel recently announced by the Charles H. Tenney organization (Electrical World, February 8, page 12.

Graybar Organization Announces Changes

Announcement has been made by the Graybar Electric Company, Inc., of the following changes in personnel:

At Kansas City J. G. Dean has been appointed credit manager and M. O. McIlvain service manager. Mr. Dean has been in the accounting department of Graybar in Kansas City since 1920 and Mr. McIlvain has a still longer record (since 1917) with the service department at this branch.

At Cleveland R. D. Paine, formerly service manager, has been made assistant manager. Mr. Paine has been associated with Graybar since 1923, when he was employed by the accounting department of the general offices in New York. After ten years of accounting and service experience at several Graybar branches he became service manager at Detroit. In February, 1935, he was transferred to Cleveland as service manager of that branch.

At St. Louis Willard E. Henges, merchandising manager for many years at St. Louis, has been appointed assistant manager of that branch. Mr. Henges started with Graybar back in 1913. His entire business career has been with the St. Louis branch of Graybar. Since 1919 he has been active in the sales department and was made merchandising manager in 1928.

•

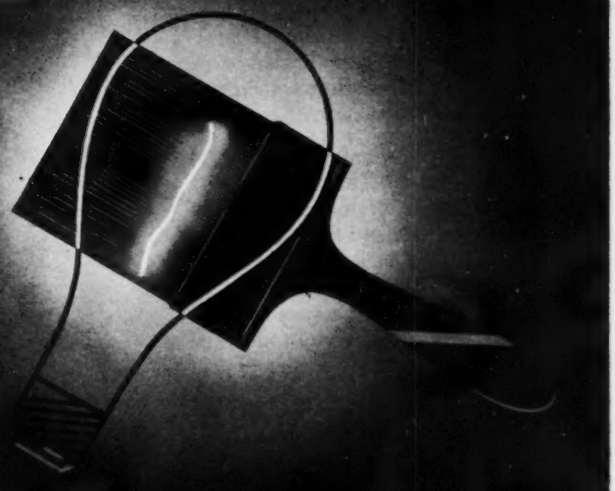
▶ Henry L. Gray of Seattle, Wash., has been engaged by the city commission of Yakima, Wash., to conduct a general survey of the light and power situation in that city and vicinity and to report upon the feasibility of a municipal system. Mr. Gray served for seven years as chief engineer for the Public Service Commission of Washington. He is a member of the American Institute of Electrical Engineers.

▶ Sir Herbert Samuel, well-known British politician and leader of the Liberal party, has been elected chairman of the Palestine Electric Corporation to succeed the late Marquis of Reading. Among his fellow directors are such distinguished personages as Lord Hirst, chairman of the General Electric Company; Lord Melchett, director of Imperial Chemical Industries, Ltd., and Edward Baron, the tobacco magnate.

▶ A. Murray McCrimmon, who has been acting secretary and controller of the Ontario Hydro-Electric Power Commission since 1909, has been appointed secretary to succeed W. W. Pope, resigned. For many years Mr. McCrimmon was an official resident in Brazil of the Brazilian Traction, Light & Power Company. A graduate of McGill University, he went to Brazil in 1919 to join the Rio de

PAINT & ELECTRICITY

JOIN FORCES . . . TO PROMOTE BETTER LIGHT FOR BETTER SIGHT



PAINT is an obvious ally of artificial light in the movement toward Better Light — Better Sight. Improper diffusion of light from walls, ceilings and other areas in the visual field takes a huge yearly toll from business—rejected and slow production, lost time, labor turnover, accident compensation, etc.

As a part of its active co-operation with the electrical industry, the Pittsburgh Plate Glass Company has made an intensive study of the relation between paint and light. The result is a complete line of interior finishing materials designed to provide a *double business gain:* (1) Maximum use of available natural and artificial light. (2) Lower maintenance costs.

These finishes are known as *Glorified Light Products.* They are explained fully in our book, "Glorified Light." If you are concerned with production or plant maintenance, you should have this book. Bring your file of information about modern maintenance methods up to date. Send the coupon below.

TUNE IN: *Pittsburgh Symphony Orchestra, playing the music you love, every Thursday, 8:00 P.M. (E.S.T.) beginning Feb. 27th, N.B.C. Blue Network and Associated Stations.*

3 FINISHING SYSTEMS

All Glorified Light Products convert *raw* light economically into *useful* light. But to offer all types of industry the added feature of lower maintenance costs, three separate finishing systems were created:

- **THE SNOLITE SYSTEM.** A line of superior whites for all normal interior exposures. Flat, Satin, Low Eggshell, Standard Eggshell, Semi-Gloss, Gloss. Tints available in Satin and Semi-Gloss.
- **THE SNOTEX SYSTEM.** For all abnormal interior exposures except where fungus may be expected. The highest attainable resistance to yellowing or discoloration in the presence of humidity, fumes, gases, heat or unusual absence of daylight.
- **THE FUNGUSIDE SYSTEM.** For use where fungus exists or may be expected. Of special importance to bakers, brewers, distillers, cheese manufacturers, dairymen, packers and others who must wage a constant battle against bacteria, mold or other types of fungus.

Paint PITTSBURGH PLATE GLASS COMPANY *Glass*

Makers of Wallhide Paint • Waterspar Enamel and Varnish • Florhide • Sun-Proof Paint • Gold Stripe Paint Brushes
Polished Plate Glass • Pennvernon Window Glass • Carrara Structural Glass • Mirrors • Duplate Safety Glass

PITTSBURGH PLATE GLASS CO.
Paint Division, Dept. V-2, Pittsburgh, Pa.

Please send me a copy of your new book, "Glorified Light."

*Name*_____

*Firm*_____

*Address*_____

Janeiro Tramway Light & Power Company, where he received a thorough training in every field of public utility operation. He became assistant to the late F. A. Huntress, vice-president in charge of the Brazilian Traction Company's operations in Brazil, and was for a time assistant secretary of the Canadian holding company as well as the various subsidiary operating companies in Brazil. Mr. Pope, the retiring secretary, had served with every commission since Hydro's inception. His resignation was caused by ill health.

▶ EDGAR A. LOEW, professor of electrical engineering at the University of Washington, Seattle, has been appointed dean of the College of Engineering.

▶ E. S. WHITLOCK was elected president of the Electric League of Richmond (Va.) at the recent annual dinner meeting. Morris Hunter was named vice-president, Edgar M. Andrews secretary and C. F. Bennett treasurer.

▶ HARRY J. WALTON, sales manager of the Malden (Mass.) Electric Company and the Malden & Melrose Gas Light Company since 1918, and associated with the properties of Charles H. Tenney & Company north of Boston for about 25 years, has been appointed assistant manager of the Malden Electric Company. These properties are now affiliated with the New England Power Association.

▶ WILLIAM NOYES, operating engineer of the Public Service Company of New Hampshire, Manchester, has been elected chairman of the New England System Operators Club for 1935-36, succeeding George A. Elz. E. C. Brown, assistant manager of the Connecticut Valley Power Exchange, Hartford, has been elected secretary of the club.

▶ H. WARREN LAWRENCE, formerly general sales manager of the United Electric Light Company, Springfield, Mass., affiliated with the Western Massachusetts Companies, has been appointed assistant to the manager of the Connecticut Power Company, with headquarters at Middletown. Charles P. Golding, formerly promotion manager of the United company, has been made sales manager.

▶ W. E. HOLLAND, vice-president in charge of engineering, Philadelphia Storage Battery Company, Philadelphia, Pa., has resigned as an officer and director of the company and is retiring from active business. He entered the business as a tester with the Edison Storage Battery Company in 1902 and shortly after was made chief of the battery experimental department. Mr. Holland was engaged in research work with the inventor and was appointed chief electrical engineer of the Edison Company at Orange, N. J., in 1911. Since 1918 he has been with the Philadelphia Storage Battery Company.

OBITUARY

C. S. MacCalla

Clifford S. MacCalla, vice-president and division manager of the Ohio Edison Company, Youngstown, who died last week (ELECTRICAL WORLD, February 8, page 13) became identified with the Ohio properties in 1923 and at that time was already equipped with extensive experience in utility operation, both in the power and railway fields.

A native of Wallingford, Pa., and a graduate of Lehigh University, he spent a short period of service with the telephone and electric companies of Philadelphia and with the Edison Electric Illuminating Company of Brooklyn, now the Brooklyn Edison Company. He then entered the foreign department of the General Electric Company and was appointed principal assistant engineer in charge of the installation in Sydney,

C. S. MacCalla

Australia, of the generating plant, substations and railway equipment for the tram lines of the New South Wales government. Later he went to Schenectady and subsequently returned to the Brooklyn utility.

In 1903 Mr. MacCalla began a fifteen-year service with the Washington Water Power Company, Spokane, successively as assistant to the general manager, assistant general manager, general manager and vice-president and general manager. Returning East, he became vice-president and general manager of the Virginia Power Company of Charleston, W. Va., and was also identified with the Coalburg Colliery Company, Ronda, W. Va., as vice-president. His next move was to Ohio, where he took a prominent part in the affairs of the East Central Division of the old National Electric Light Association. Mr. MacCalla was a fellow of the American Institute of Electrical Engineers and a member of the American Society of Civil Enginers.

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▶ CLAUDE W. MITCHELL, chief electrical engineer, Board of Fire Underwriters of the Pacific, San Francisco, Calif., died November 27 in his fifty-eighth year. Mr. Mitchell was employed by the Board of Fire Underwriters of the Pacific as an electrical inspector, a position which he held until 1912, when he was made electrical engineer. Since 1927 he had been chief electrical engineer. Mr. Mitchell was for many years a member of the electrical council of the Underwriters' Laboratories, Inc., and of the electrical committee of the National Fire Protection Association. He took part in the preparation of the National Electrical Code and was the author of a series of articles on electrical construction and interpretation of code rules. He was a member of the A.I.E.E.

▶ W. H. HORTON of the West Penn Power Company died suddenly in Pittsburgh, Pa., on February 10, following an operation. Mr. Horton had taken a prominent part in industry code, standards and wiring activities and had a host of friends in the industry.

▶ JAMES R. BIBBINS, mechanical and consulting engineer, died at his home in Washington, D. C., January 27. He was the first head of the Department of Transportation and Communication of the United States Chamber of Commerce. Since 1923 Mr. Bibbins had been a consulting engineer in transportation and its related economic and civic problems, with headquarters in Washington. From 1909 to 1921 he was associated with Lieut.-Col. Bion J. Arnold and previous to that connection he was commercial engineer with the Westinghouse Machine Company, East Pittsburgh. He also served in various technical capacities with the Detroit Public Lighting Commision, Detroit Edison Company and the Detroit United Railway. Mr. Bibbins was a graduate of Baltimore City College and the University of Michigan.

▶ HAROLD F. EDDY, formerly mechanical engineer for Consumers Power Company and the Commonwealth Power Corporation of Michigan, died at his home at Hartsdale, N. Y., December 18. He was 49 years of age. Following graduation from the University of Maine, his native state, Mr. Eddy joined the old Commonwealth Power Company in 1910, in general engineering work under the late J. B. Foote. He made the basic calculations for the electrical and mechanical design of the 140,000-volt transmission line from Cooke Dam on the Au Sable to Flint. Later he specialized in mechanical engineering, assisting Mr. Foote in the design, improvement and modernization of the company's various steam plants. For some years Mr. Eddy was connected with the production and transmission department and subsequently became associated with the engineering organization, where he remained until his resignation in 1928. At that time Mr. Eddy entered the research department of the Foster Wheeler Corporation of New York.

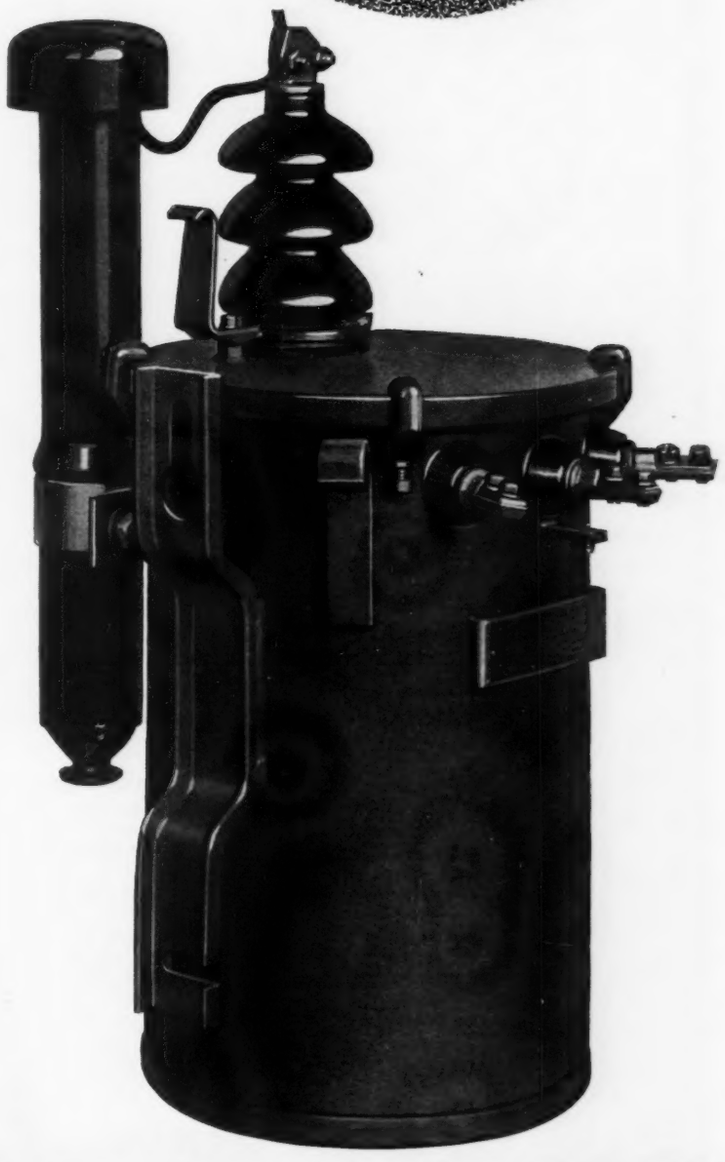
Now Available!

A NEW SURGE PROTECTED RURAL LINE TRANSFORMER

HIGH EFFICIENCY TYPE—ALL SIZES

IN addition to Reduced Efficiency Rural Line Transformers in sizes 1 kva to 3 kva, Allis-Chalmers offers a new transformer for rural line service designed for high all day efficiency with integrally mounted surge-diverter and protective gap, and available in all N. E. M. A. ratings — 1½ to 25 kva inclusive — and for all commercial voltages.

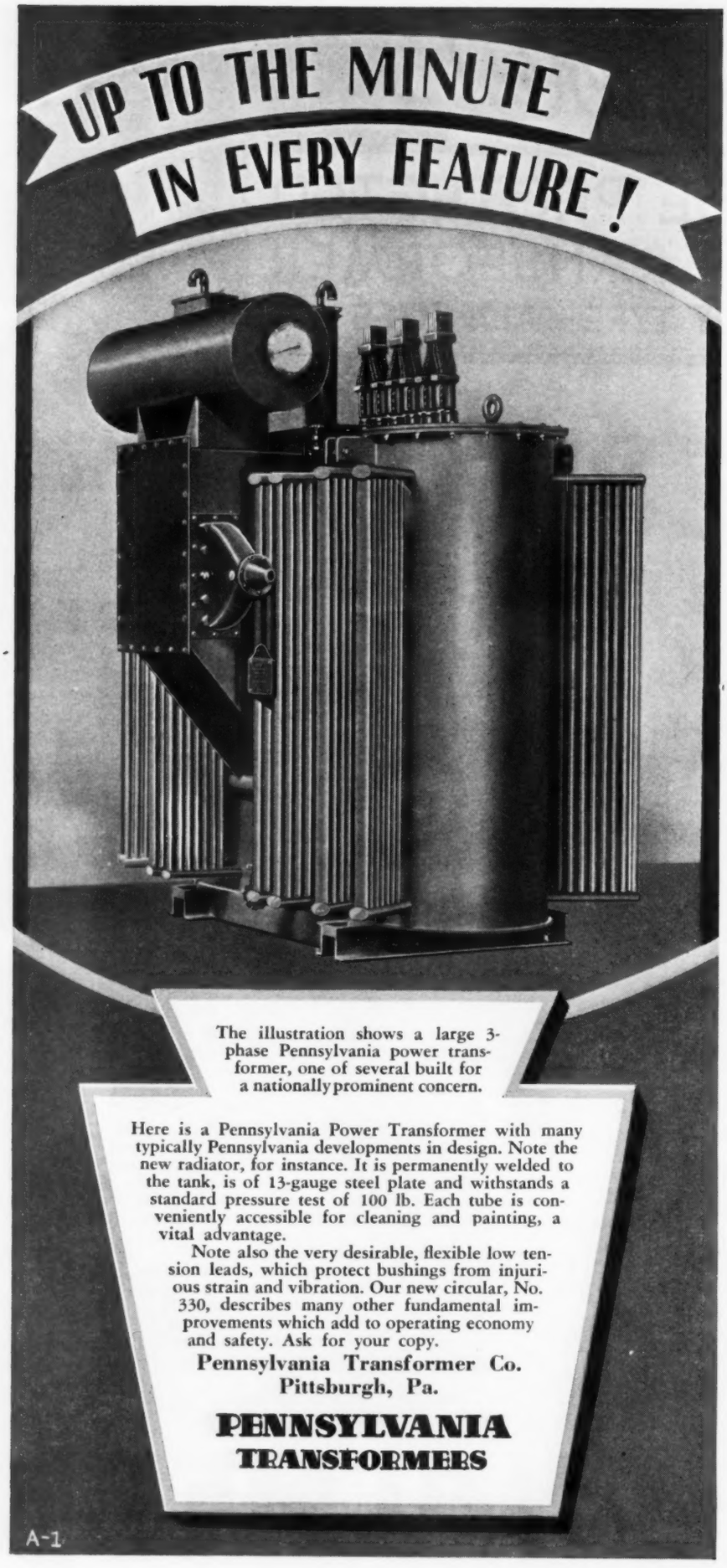
Use of this new type transformer permits the economies of grounded neutral rural line extensions to be obtained with larger sizes of transformers than heretofore . . . with conventional efficiencies . . . with or without a surge-diverter integrally mounted.



Ask the nearest Allis-Chalmers representative for additional information concerning this new transformer.

ALLIS-CHALMERS

— Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin, U.S.A. —


UP TO THE MINUTE
IN EVERY FEATURE !
The illustration shows a large 3-phase Pennsylvania power transformer, one of several built for a nationally prominent concern.
Here is a Pennsylvania Power Transformer with many typically Pennsylvania developments in design. Note the new radiator, for instance. It is permanently welded to the tank, is of 13-gauge steel plate and withstands a standard pressure test of 100 lb. Each tube is conveniently accessible for cleaning and painting, a vital advantage.
Note also the very desirable, flexible low tension leads, which protect bushings from injurious strain and vibration. Our new circular, No. 330, describes many other fundamental improvements which add to operating economy and safety. Ask for your copy.
Pennsylvania Transformer Co.
Pittsburgh, Pa.
PENNSYLVANIA
TRANSFORMERS
A-1

Useful Range of A.C. Power Transmission

[*Continued from page 23*]

square inch a voltage of 220 kv. may be carried by the line. This allows an ample factor of safety, for the breakdown voltage of the air is more than three times the applied crest voltage and the corona-forming voltage is in the neighborhood of twice the applied voltage. (This statement is contingent upon further experiment establishing the validity of the theory upon which it is based.) Such a line would be quite safe from lightning, fog, rain, sleet and other atmospheric disturbances. The expense of its construction would be moderate, being probably between the cost of overhead line and oil-filled cable. Its life would be the life of the pipe, and the only important maintenance would be provision for constant pressure, which an automatic air compressor would supply. A possible source of trouble would be the conductor supports within the pipe; this problem has not been studied, but is no doubt not insurmountable. Such a compressed-air cable for carrying power is applicable to any type of high-voltage service, but would probably be found most immediately useful where neither overhead lines nor oil-filled cable could readily be used.

Consideration of the compressed-air cable is introduced here because of its inherent properties of inductance and capacitance. The close spacing of conductors makes inductance lower than on an overhead line, and capacitance higher, by a factor of about 2½ times. This means that the power that may be transmitted, as a half-wavelength line, without a resonant rise of voltage in the middle of the line, is greater in the same proportion; for a 220-kv. line it would be more than 300,000 kw. Such a line would be worthy of serious consideration when it became necessary to carry a large block of power over a distance exceeding 200 miles, with complete freedom from interruptions of all kinds.

5. *The "Loaded" Line*—In case a line is something less than a half-wave length long and is to be operated as a "tuned" line, its electrical length can be artificially increased by "loading." Telephone lines are commonly "loaded" with inductance coils in the line with the double effect of altering their characteristics of transmssion and increasing their electrical length. The same method can be used to lengthen electrically a power line, but it is not good to do so, because an increase of inductance results (as has been mentioned above) in a decreased load limit

if overvoltage at the middle of the line is to be avoided. On the other hand, however, the line may be "loaded" by increasing its capacitance to neutral, and at the same time that it is lengthened electrically it will have its power limit raised.

A 500-mile line, for example, may be "loaded" with three or four static condensers, located at intervals along the line, and connected from line to ground. The capacitance of the condensers must be about eight times that of the line, for the length of the line is only about one-third of a half-wave-length line. The load limit of such a line would be, at 220 kv., about 400,000 kw. But the capacitance required to "load" such a line is unreasonable, for the required condenser capacity would be in the neighborhood of 1,000,000 kva. The same results could be obtained from a line "tuned" with a compensating section with much less condenser capacity. It would be only a longer line, of 800 miles or more, that could be most advantageously "tuned" by "loading."

BOOK REVIEWS

Electrical Measurements

By Cobden Turner and E. H. W. Banner. Instruments Publishing Company, 1117 Wolfendale Street, Pittsburgh, Pa. 354 pages illustrated. Price, $4.50.

Purposely kept simple and free of mathematics and theory, this British book has been written for those who are most interested in applying available electrical measuring devices to specific objectives. Fields presented are those of current, voltage, power and circuit quantities, along with electrical methods for speed, temperature, illumination and a short chapter on boiler house measurements. Watt-hour metering is only mentioned. A unique chart shows the comparative range of various instruments appropriately used in *E*, *I*, *R* measurements in power, audio and radio frequencies.

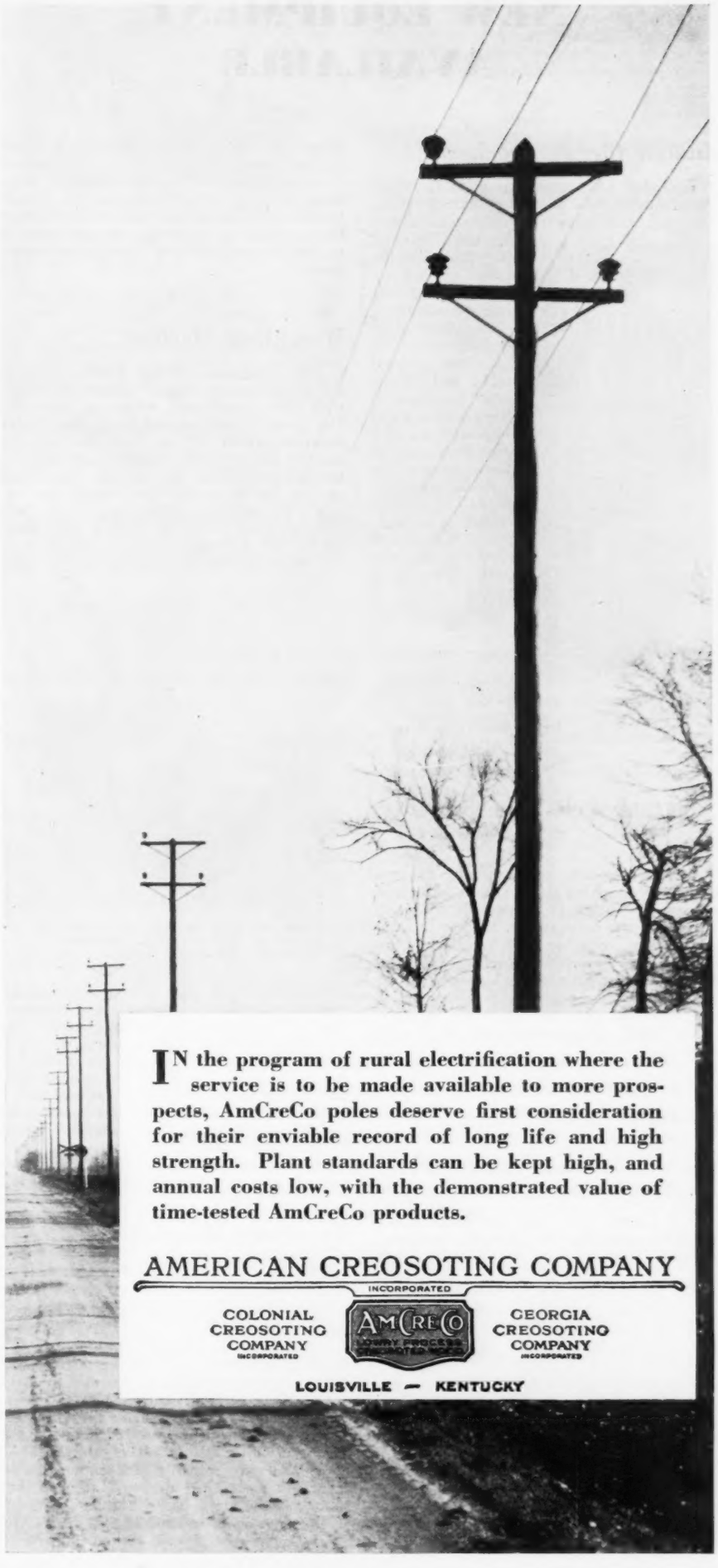
•

Wood Handbook

Prepared by Forest Products, Laboratory of U. S. Department of Agriculture. Obtainable from Superintendent of Documents, Washington, D. C. 306 pages. Price, 25 cents.

This handbook, specifically adapted to the principal classes of wood use, brings the requirements of utilities to definite focus with the properties and characteristics of American wood species as a whole in their treated and untreated condition. Characteristics of standard wood preservatives are explained and the merits of the various processes set forth in relation to the kind of wood and the type of use. The hazards of decay and of attack by insects, marine borers, birds and rodent animals are dealt with and corrective measures shown.

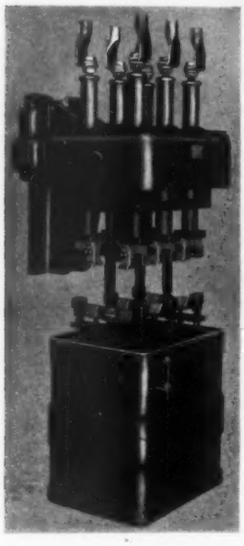
Poles are taken up specifically in a short section of the handbook. The properties of species adapted to pole use are reviewed and data are given on volume of poles, ultimate fiber stresses, pole dimensions, effective preservation treatments for new and for standing poles and the life to be expected of poles in service.


IN the program of rural electrification where the service is to be made available to more prospects, AmCreCo poles deserve first consideration for their enviable record of long life and high strength. Plant standards can be kept high, and annual costs low, with the demonstrated value of time-tested AmCreCo products.
AMERICAN CREOSOTING COMPANY
INCORPORATED
COLONIAL CREOSOTING COMPANY INCORPORATED
AMCRECO
GEORGIA CREOSOTING COMPANY INCORPORATED
LOUISVILLE — KENTUCKY

NEW EQUIPMENT AVAILABLE

Indoor Circuit Breaker

Equipped with expulsion ports for high-speed interruption and rated at 50,000 kva., this unit has many applications in indoor service. This oil circuit breaker has high-speed inclosed mechanism, frame construction with deep overhanging flange, all poles in a single tank, and "Bakelain" bushings. It has an oil and gas separator, heavy arcing contacts of large thermal absorption capacity, is flexible in mounting arrangements and may be operated manually by solenoid or motor.



Type DX-20, furnished for 600 amp. at 15 kv., 1,200 amp. at 7.5 kv. and 2,000 amp. at 5 kv. **Condit Electrical Mfg. Corp.**, Boston, Mass

•

Separate Well Tube System

"Thermospeed." **Taylor Instrument Co.**, Rochester, N. Y.

A speed response to temperature changes closely approaching that of bare bulb tube systems is claimed to be possible with this separable well tube system for use in locations where corrosion and erosion protection of the temperature-sensitive bulbs of recording thermometers is necessary. The system may also be used with controllers to give improved accuracy. Extreme accuracy in indicating every temperature variation is claimed.

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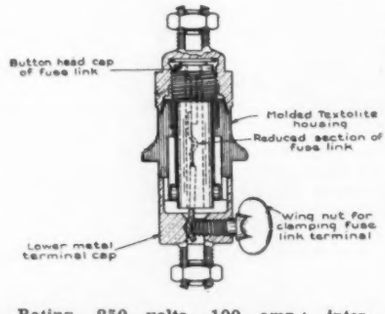
Secondary Fuse Cutout

This indicating secondary fuse cutout was designed to (1) protect distribution transformers from secondary faults; (2) isolate service entrance faults; (3) produce diversity of loading and overcome light flicker without increasing transformer capacity.


Button head cap of fuse link
Molded Textolite housing
Reduced section of fuse link
Wing nut for clamping fuse link terminal
Lower metal terminal cap

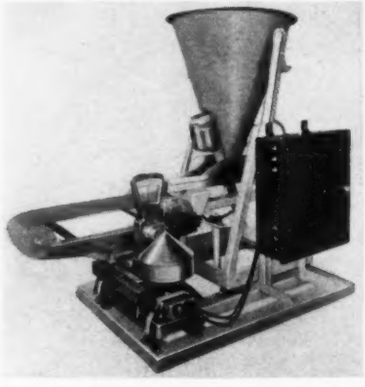
Rating, 250 volts, 100 amp.; interrupting rating, 3,000 amp., 60 cycles. **General Electric Co.**, Schenectady, N. Y.

When the cutout operates the textolite housing and lower terminal are forced downward by a spring surrounding the fuseholder tube, thus giving a visual indication of outage. Cutout terminals of the split connector type are provided for connection to conductor or to clamp terminal of a distribution transformer.

•

Weighting Machine

Bulk materials, except liquids, can be fed at any desired rate per minute by weight with this continuous weighting machine. The device is built around a pulsating feeder conveyor which acts to load the belt for any set rate of feed. Feed is actuated by two vibrating units, one on the trough and one on the hopper. The trough unit advances the material in the trough to the belt and the other keeps the hopper walls moving to prevent hopper supply arching over. The belt operates at constant speed. The scale is equipped with a sensitive electric control to register fractional ounce changes, either over or under. These changes are communicated to the feeder control to speed up or slow down discharge from feeder trough to belt. Load on the belt is balanced by a counterweight so that any movement of the scale due to over- or underfeeding acts through the controls to make an immediate correction.



Units are built to order in sizes from pounds to tons per hour. **Syntron Co.**, Pittsburgh, Pa.

•

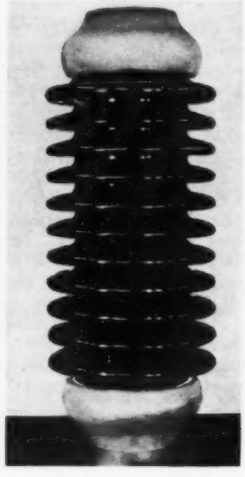
Automatic Motor Base

"Straitline" automatic ball bearing motor base. **Allis Chalmers Mfg. Co.**, Milwaukee, Wis.

Used with the new vari-pitch "Texrope" sheave, this motor base maintains uniform belt tension throughout the speed range adjustment. A handwheel on the motor base moves the motor a sufficient distance to compensate for change in centers between shafts resulting from the variation in the diameter of the vari-pitch sheave. A dial indicator on the base indicates tension of the V-belts. Four ball bearings, totally inclosed and lubricated for the life of the unit, support the motor and the upper half of the base. Travel of the base is in a straight line and it is always anchored to its foundation.

Station Post Insulators

These insulators consist of closed end porcelain posts to which caps are cemented to permit mounting and attachment of switch parts, bus support clamps and other substation apparatus. Freedom from puncture, resulting from absence of internal conductive material, and full separation of live parts of the insulator are features. All hardware being attached externally to the one-piece porcelain post assures maximum reliability against the hazard of cracking and deterioration with time and temperature effects. These insulators possess the same strength inverted that they have in the upright position, thus permitting use of underslung equipment with security.



Complete line available, catalogued in bulletin No. 123. **Lapp Insulator Co.**, Le Roy, New York.

•

Dielectric Tester

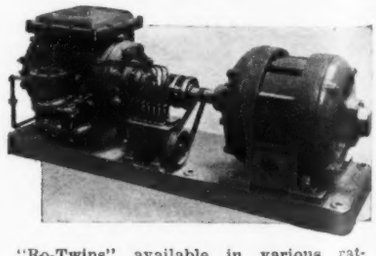
Voltages available, 500, 1,000, 1,250, 1,500, 1,750, 2,000 or 2,500 volts; short-circuit current is limited to 1 amp. at 500 and 200 m.a. at 2,500 volts. **Acme Electric & Mfg. Co.**, Cleveland, Ohio.

Actual application of standard testing voltage of double the rated voltage plus 1,000 to the insulation of the appliance, device or equipment under test is accomplished by this unit. Windings with rotted, old or defective insulation below the minimum safety standard will break down under test voltage, thus necessitating rewinding. The test unit consists of a leakage-type transformer the secondary voltage of which is controlled by a tap-switch to provide a wide range of voltages.

•

Rotary Compressor

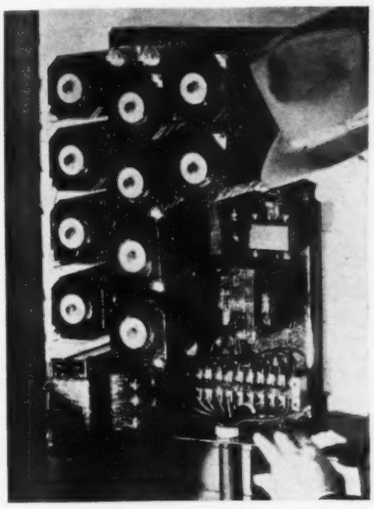
Both stages and the intercooler of this new two-stage, sliding-vane, rotary air compressor are contained in a single casting. Compared with the usual design of two-stage rotary having separate cylinders, it offers the advantages of greatly reduced length and floor space, one stuffing box and one coupling, no external air piping between stages and a simpler lubricating system. Shaft alignment is said to be easily maintained since the machine has only two bearings.



"Ro-Twins" available in various ratings from 20 hp., 1,740 r.p.m., to 100 hp, 690 r.p.m., for air deliveries from 60 c.f.m. to 412 c.f.m. at 100 lb. G. **Allis-Chalmers Mfg. Co.**, Milwaukee, Wis.

Static Voltage Regulator

Absence of contacts, tubes or any moving parts removes the necessity for frequent inspection, adjustment or maintenance of this regulator, which is for use with small a.c. units. Rectified a.c. current proportional to



For units where exciter field current is 1 amp. or less. **Westinghouse Electric & Mfg. Co.**, E. Pittsburgh, Pa.

the load is used to compound the exciter field, varying with the load on the machine. Energy for required additional voltage corrective effect is obtained from generator potential through a combination of reactor and dry-type rectifier circuit.

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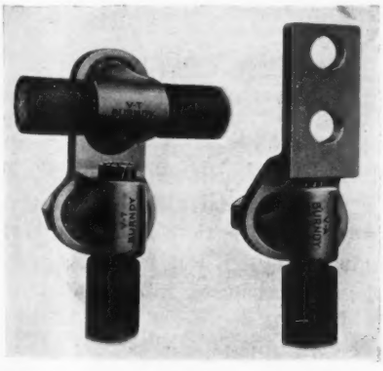
Clamp Connectors

A Durium U-bolt, broadened at the clamping area, is the basis of design in this group of wire and cable connectors. The advantage claimed for the design is that each element can accommodate a wide range of



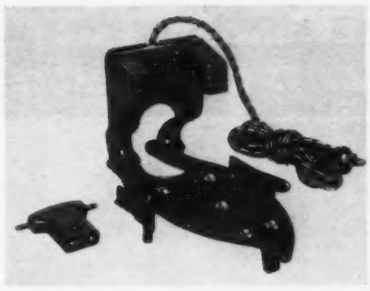
"V"-Line: available in T, lug, coupler, reducer and stud connectors for conductors ranging in size from No. 8 to 2,000,000 circ. mil. **Burndy Engineering Co.**, New York City.

cable sizes and yet, because of the broad pressure area, will not injure the cable strands. Durium construction makes possible use of these clamps along the seacoast and in corrosive industrial atmospheres, since they will not corrode or season check.

•

Iron Cord Eliminator

Any electric flatiron can be made "cordless" by using this device, which heats the iron during the period when pieces are being arranged or straightened on the board. When the iron is placed on the stand the



"Cord-Elim," can be used with any standard iron. **Hayruss Corporation**, Philadelphia, Pa.

special adapter plug on the iron mates with contacts on the stand, completing the electrical circuit and heating the iron. This device eliminates the annoyance of dragging the iron cord across the board while working.

•

Industrial Luminaire

Equipped with 33-in mercury-vapor tube and a 200-watt incandescent lamp; rated at 500 watts. **General Electric Vapor Lamp Co.**, Hoboken, N. J.

Color characteristics said to approach actual daylight more closely than any commercial light source heretofore available are obtainable from this "circular mercury-incandescent." Fixture consists of a unit in which a circular mercury vapor tube and an incandescent lamp are combined beneath one reflector to provide the desired spectral balance. It is recommended for industrial applications involving accurate color differentiation, critical inspection or manufacturing operations which involve visual problems.

•

"Pyrex" Lightning Arrester

L-M type "C," 9,000-volt size, for cross-arm or flat mounting. **Line Material Co.**, Milwaukee, Wis.

Third size — 9,000 volts non-grounded system — in this line of "Pyrex" glass body lightning arresters is announced. This size required special development work to adapt the glass body idea to the enlarged unit. Particular feature claimed for this design is sturdiness, all parts and components generously sized.

ENGINEERING DATA FROM MANUFACTURERS

Bulletins and catalogs now available to engineers by manufacturers and associations

Recent bulletins of the General Electric Company covering design and construction features applications, characteristics and specifications of various of their products and equipment include:

	Pages
GEA-2048—Pyranol transformers	7
GEA-1994—Cable type fuse links	4
GEA-2209—Bearing temperature relays	2
GEA-1791B—Service cable	12
GEA-246D—High-speed synchronous motors, 7500 series	4
GEA-1768A—Cathode-ray oscillograph	4
GEA-1993A—Inclosed, indicating, drop-out fuse cutout	6

A new lamp catalogue designed for the industrial lamp buyer and containing data on the light absorption of colors and tables showing recommended illumination intensities for various industrial interiors is obtainable from Hygrade Sylvania Corp., Salem, Mass.

Specifications, properties and methods of application of thermostatic bimetals are assembled for reference in a "Blue Book of Thermometals" published by H. A. Wilson Company, Newark, N. J. Ten full-page charts showing deflection and force characteristics, together with design formulas, provide data for bimetal applications in the field of temperature indication and thermal control.

The Ohio Electric Manufacturing Company, Maurice Avenue, Cleveland, Ohio, has just issued new sheets Nos. 4, 5, 6 and 7 of bulletin 212-B, showing dimensions of various size motors offered in standard frames. Also issued are sheets 10, 11, 12, 13 and 14 of bulletin 211-A, giving dimensions of popular special designs and identifying them with standard frames.

Pin-type and guy strain insulators are the subject of a 28-page catalog now available from Porcelain Products, Inc., Parkersburg, W. Va. Specifications and dimensions of each insulator are included.

Principles behind the operation of domestic electric refrigerators are explained and illustrated in a simple non-technical manner in a 20-page booklet "Ice By Wire," written by the chief refrigeration engineer of Westinghouse Electric & Manufacturing Company, E. Pittsburgh, Pa.

A complete line of all types of electrical connectors is listed in catalog 33C of the Burndy Engineering Company, Inc., 305 E. 45th St., New York City. Uses of each type connector are illustrated with photographs and drawings and complete data and sizes and dimensions are given.

Isolating gaps for the protection of primary distribution transformers are discussed in General Electric bulletin GEA 2210. The principle of operation is explained and illustrated and the available gaps described.

Construction features of Reliance induction motors are detailed and amply illustrated in three new bulletins: Bulletin 118—squirrel-cage frames 202-405, type AA motors. Bulletin 119—squirrel-cage frames 444-585, type AA motors. Bulletin 121—fully inclosed fan coolers, type AA form F. These folders may be obtained from Reliance Electric & Engineering Company, Ivanhoe Road, Cleveland.

"Air Conditioning" is the title of an Electric Bond & Share Company report to its operating units. It sizes up the progress and market, gives installation statistics, contrasts systems and records apparatus developments. It is privately issued and copies unfortunately are not available to the public.

A 31-page reference section in the 1936 catalog of Pheoll Manufacturing Company, 5700 Roosevelt Road, Chicago, maker of screws, bolts and nuts, contains tables covering standard specifications for screws, bolts, nuts, etc. Weight tables, standard packing tables, decimal equivalents and discount multiples are also given.

Yesterday

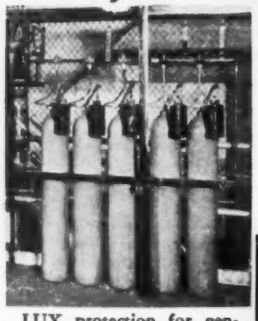
FIRES TAXED MAN POWER TO LIMITS OF ENDURANCE

● One of the earliest types of fire engines used in America. Other interesting illustrations of old fire fighting methods will be used in Lux Fire Protection advertising in coming months.

(Permission by American Mutual Alliance)

Today

FIRES ARE EXTINGUISHED . . . . WITHOUT HUMAN HANDS



LUX protection for generator at Kips Bay Station of New York Steam Corp.

● What would fire mean today in the great generator plants, transformer vaults, oil switch rooms, etc., that produce light and power? With Lux protection there is no cause to worry. If fire breaks out even in an unattended substation (more and more stations are being made automatic) your Lux System will come into action at the first flash or heat—saving costly equipment—maintaining service without interruption.

If you are not certain of what Lux carbon dioxide protection can do for you, let us send you our new booklet "Smothering Fire in Power Plants." Write for your copy today.

Walter Kidde & Company

Bloomfield, New Jersey

MORE THAN 4,000,000 H. P. IS LUX PROTECTED

LUX

To the Man Who Controls a Business

Increased estate taxes raise serious questions for the man who owns or controls his own business. If an estate consists of one business, the need for cash to meet heavy estate taxes may necessitate a forced sale with consequent sacrifices, including loss of control. ¶ Improved market conditions afford an opportunity to forestall such situations, through enhanced marketability and collateral value resulting from wider distribution and listing of the securities on a recognized exchange.

F. EBERSTADT & CO.

Incorporated

INVESTMENT BANKING

39 BROADWAY NEW YORK CITY

One Boring to Find Ground Resistance

[*Continued from page 29*]

diameter as test hole and inserting the assembly in a large water rheostat to simulate earth tests. Resistance measurements between the electrodes in water rheostat were made, also the resistance of a column of water taken from the rhesotat was made to determine its resistivity per cubic centimeter. It was found that the multiplier was approximately 20. The relation between earth resistivity per cubic centimeter and the resistance of a single ⅝-in. diameter by 8-ft. rod was determined by the formula:

$$*R = \frac{P \text{ Log}_e \frac{4L}{d}}{2\pi L}$$

Where R is total ohms resistance of driven rod.
P is resistivity of earth in ohms per C.C.
L is length of rods in centimeters.
d is diameter of rod in centimeters.

Typical Field Tests

Depth Below Surface	Test Hole Locations and Milliamps. at 4.5 Volts A	B	C
1 ft.	10.0	4.50	4.00
2 ft.	7.0	2.00	3.25
3 ft.	3.0	1.75	4.00
4 ft.	1.5	1.25	9.00
5 ft.	1.	1.50	12.00
6 ft.	1.0	1.60	12.00
7 ft.	1.0	1.50	12.00
Average	3.5	2.01	8.03

	Location A	B	C
Ratio increase in resistance within 8 ft. of surface	10.	3.0	—3.0
Average resistivity of earth, ohms/C. C. $= \frac{20 \times 4.5 \text{ volts}}{\text{ave. milli-amp.}}$ Or	25,700	44,900	11,200
Calculated resistance of single 8-ft. rods, ohms	108	188	47
Actual resistance of 8-ft. rod (meggered), ohms.	125	205	.....

*From Bureau of Standards "Ground Connections for Electrical Systems." Paper No. 108.

The method discovers much interesting and worth-while information due to the usually highly stratified condition of earth resistivity. From numerous tests it was found that earth resistivity changed most remarkably for different depths at the same locations. In upland country, not in mineral districts, the resistance of the earth usually increases very rapidly at increase of depth below surface even in moderately dry weather. This condition is shown to be due to vegetable matter and weather action on the top soil. The surface water permeating downward from the surface produces a permanent treatment for the first few feet of earth. In valleys and lowland country the variation in earth resistivity with depth is more uncertain. Usually there is 400 or 500 per cent plus or minus variaton in resistivity within a depth of 10 ft.

SALES OPPORTUNITIES IN NEW CONSTRUCTION

BIRMINGHAM, ALA.—Alabama Power Company is arranging plans for rural electrification project in 1936, comprising about 500 miles of transmission and distributing lines, with power substation and service facilities. Proposed to begin work soon. Cost close to $700,000.

MEADVILLE, PA.—Viscose Company plans installation of motors and controls, conveyors, regulators, etc., in new addition to rayon mill. Cost about $1,200,000. Main offices of company are at 200 Madison Avenue, New York, N. Y.

BROOKLYN, N. Y.—Signal Supply Officer, United States Army, Army Base, Brooklyn, receives bids until February 18 for quantity of voltage regulator sets (Circular 41); until February 26, for quantity of coil units, charts, dials, etc. (Circular 131); until March 2, for 7,040 feet telephone cable and six reels (Circular 133).

BOWLING GREEN, VA.—Farmers Rural Utilities, Inc., Bowling Green, recently organized, plans transmission and distributing lines in parts of Hanover, Orange, Spotsylvania and other counties for rural electrification, totaling about 400 miles, with power substation and service facilities. Fund of $366,000 has been secured through Federal aid and work is scheduled to begin soon.

LOS ANGELES, CALIF.—Metropolitan Water District, 306 West Third Street, receives bids until March 13 for large electric-operated pumping plant at Eagle Mountain on line of Colorado River Aqueduct, including inlet works and outlet structures, electrical switching station and accessory appurtenant works (Specifications No. 143). F. E. Weymouth is general manager and chief engineer. (Cost reported over $500,000.)

LIBERTY, TEX.—Will take bids early in March for equipment for city-owned electric power plant, including three 150-kw. generator units and accessories, switchboard, etc. Fund of $95,000 has been secured through Federal aid. Garrett Engineering Company, Houston, Tex., is consulting engineer.

ATLANTA, GA.—Chevrolet Motor Company, 3044 West Grand Boulevard, Detroit, Mich., plans installation of motors and controls, regulators, conveyors, electric hoists and other equipment in new addition to assembling works at Atlanta. Cost close to $300,000.

ST. PAUL, NEB.—Howard County Rural Public Power District, care of J. C. Toman, St. Paul, recently organized, plans transmission and distributing lines for rural electrification in Howard and neighboring counties, totaling about 600 miles in all, with power substation and service facilities. Proposed to secure fund of about $675,000 through Federal aid. H. H. Henningson Engineering Company, Union State Bank Building, Omaha, Neb., is consulting engineer.

DAYTON, OHIO — Contracting Officer, Material Division, United States Army Air Corps, Wright Field, Dayton, receives bids until February 20 for 237,500 feet of aircraft power and lighting cable and 27,500 feet rubber-covered flexible cord (Circular 523).

SAN FRANCISCO, CALIF.—Pacific Gas & Electric Company is arranging fund of about $40,000,000 for extensions, improvements, maintenance and miscellaneous work in 1936, of which about $16,500,000 will be used for expansion and betterments. Work will include certain extensions in power plants, new transmission and distributing lines, power substations and switching stations, yard and other structures, with addi-

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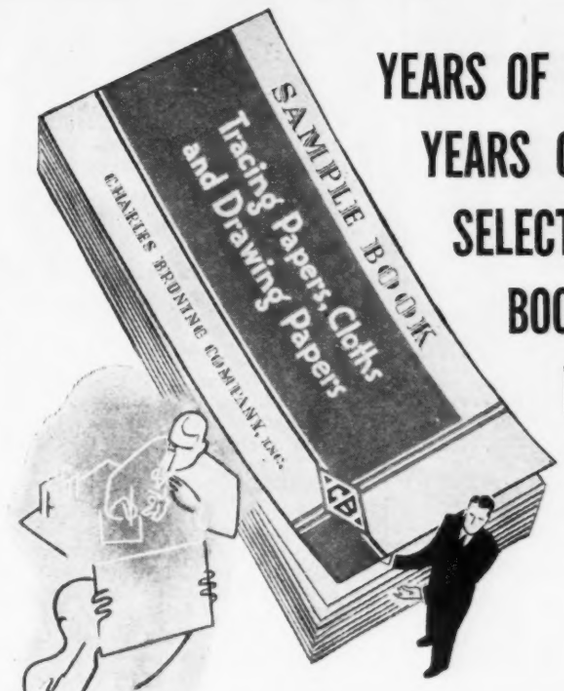

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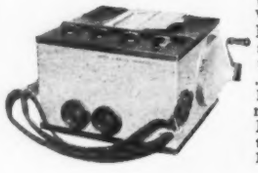

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tional service facilities for new consumers. Project is scheduled to begin soon.

CHARLESTON, S. C.—South Carolina Power Company plans rural electrification program in 1936, totaling about 100 miles of transmission and distributing lines, with power substation and service facilities. Proposed to begin work soon. Cost close to $100,000.

WAKEFIELD, MICH.—Plans new city-owned electric power plant. Cost about $60,000. Financing will be carried out through Federal aid.

CLEVELAND, OHIO—Industrial Rayon Corporation, West Ninety-eighth Street, plans installation of motors, controls, regulators, power substation facilities, conveyors, etc., in new multi-story addition to rayon mill. Cost about $1,200,000. Proposed to begin work in spring.

LOS ANGELES, CALIF.—Board of Public Works receives bids until February 18 for new ornamental lighting system on portion of Crescent Heights Boulevard; until February 19 for installation of similar system on portion of Figueroa Street.

WARREN, OHIO—Republic Steel Corporation, Republic Building, Cleveland, Ohio, plans installation of heavy-duty motors and controls, conveyors, electric hoists, regulators, cranes and other equipment in connection with extensions and improvements in strip steel mill at Warren. Cost about $500,000. Company will also expend about $700,000 for similar work at other mills in different parts of country during 1936.

BURLINGTON, N. C.—Baker Cammack Textile Corporation plans installation of motors and controls, conveyors, etc., in new knitting mill unit; local building has been leased and will be remodeled and equipped at early date. Cost close to $100,000.

CORNER BROOK, N. F.—International Power & Paper Company, Ltd., plans early rebuilding of portion of hydroelectric generating plant, used for mill service, recently damaged by flood. Loss reported over $125,000.

SEATTLE, WASH. — Continental Can Company, 615 Orchard Street, plans installation of motors and controls, conveyors, electric hoists, loaders, etc., in new multi-story addition to local plant. Cost about $120,000. Company headquarters are at 100 East Forty-second Street, New York, N. Y.

KEARNEY, NEB.—Is considering construction of a transmission line for connection with hydro-electric power plant now under construction at Sutherland, Neb., by local power and irrigation district, for municipal distribution, including power substation, electrical distributing lines and service facilities. Cost about $150,000.

BROOKLYN, N. Y.—George Ehret Brewing Company, 38 Pine Street, New York, N. Y., plans remodeling and improving former brewing plant of Eppig Brewing Company, Evergreen Avenue, Brooklyn, recently acquired, with installation of new equipment. Cost close to $300,000.

BUFFALO, N. Y.—Trico Products Corporation, 817 Washington Street, plans installation of motors and controls, conveyors, electric hoist, etc., in new multi-story addition to automotive products plant. Cost close to $115,000.

CEDAR FALLS, IOWA—Plans transmission line in Grundy County for service from city-owned electric power plant, totaling about 10 miles. Application has been made for permission.

PHILADELPHIA, PA.—Bureau of Yards and Docks, Navy Department, Washington, D. C., is asking bids (no closing date stated) for stoker motors and automatic combustion control system for battery of 12 boilers at power house, Navy Yard, Philadelphia (Specifications 8147).

Municipal Plants

TERRE HAUTE, IND.—Petition bearing 13,000 signatures urging the establishment of municipal ownership of the lighting facilities have been filed with City Council. The council referred the question to a citizens' committee which recently was named to investigate the advisability of such action.

JASPER, IND.—Announcement has been made of a reduction in rates by the city light plant. Six cents will be charged for the first 25 kw.-hr. and 2½ cents for all over that amount.

MIDDLESBORO, KY.—Judge Gus Thomas of the Court of Appeals in Frankfort overruled a motion of city officials to dissolve an injunction preventing them from constructing a municipal electric light system. The Kentucky Utilities Company obtained the temporary injunction against the Mayor and City Commissioners on the grounds that the city could not take steps to build the municipal plant without having placed the question before voters of the city in an election.

TUPELO, MISS.—This city, the first to distribute T.V.A. power, celebrated the second anniversary of its contract on February 1 by making a 10 per cent reduction in commercial and industrial rates, removing the 10 per cent surcharge in effect during the development period. Mayor Nanney announced that income from the city's sales of electricity was "more than adequate to take care of all taxes, operating expenses, fixed charges and reserves." He stated that customers paid an average of 1.81 cents a kilowatt-hour, "considerably less than one-half the national average charged by private power companies."

DESHLER, NEB. — Nebraska Supreme Court will hear arguments in another case in which the Southern Nebraska Power Company seeks to enjoin construction of the municipal power plant by Fairbanks, Morse & Company. In this case the power company appealed from a district court verdict dismissing the case in which the company charged there was collusion between the city board and contractors for construction of the plant for which $29,500 in bonds was voted. Recently the Supreme Court, in an action in which the company charged the bond issue was illegal, agreed that it was, but said that the company had sued the wrong persons and therefore sustained the verdict of the district court, and dismissed the case (ELECTRICAL WORLD, January 25, page 11).

JACKSON, OHIO—Offer of the city to sign a five-year contract for power at a rate of 1¼ cents per kilowatt-hour up to 2,000,000 kw.-hr. in any year has been turned down by the Southern Ohio Power Company. City officials refused to consider a higher rate.

SEATTLE, WASH.—The city's power merger question has been relegated to the background until after the city election of March 10. City Council has directed City Light Superintendent J. D. Ross to name the maximum price the city should pay, in spite of the proposal made by Councilman James Scavotto for an immediate independent appraisal of Puget Sound Power & Light Company properties, which Superintendent Ross is urging the city to buy. Mr. Ross had notified the council he was willing to do the work, providing the purchase figures would be withheld until after the election to prevent the merger issue from becoming a "political football." Councilman Scavotto voted for a compromise resolution, which named Mr. Ross as the appraiser without committing the council for or against the purchase, or for or against a special election in the question.